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HUGH M. WILSON, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
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TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITOR.....W. D. WEAVER
A. S. M'ALLISTER.....Associate Editor
W. H. ONKEN, JR.....Associate Editor
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PITTSBURGH MEETING OF AMERICAN ELECTROCHEMICAL SOCIETY.

One of the notable features of the very successful general meeting of the American Electrochemical Society last week was the hearty welcome extended to the society by representatives of the iron and steel industry of Pittsburgh, which is largely to be ascribed to the increasing importance in that industry of the electric furnace. There is every promise that Pittsburgh, the scene of the early work of Acheson and Hall, proposes to resume its former status as an electrochemical center, and that the electric steel furnace will soon take its proper place there as an adjunct of the Bessemer converter and open hearth. Elsewhere is given the first installment of abstracts of the papers and discussions of the meeting, lack of space preventing a full presentation in this issue. Readers will find of particular interest the abstract of the paper by Dr. Fink on ductile tungsten, which material promises to exert a most important influence in the incandescent lamp field. It was a graceful compliment to the American Electrochemical Society that the first technical account of this important achievement was reserved for one of its meetings.

ELECTRICAL EXPORTS.

There seems to be a good deal of discussion going on now as to export trade, and the dwindling margin shown by it over import trade. In some degree the discussion is mixed up with that on high prices and the high cost of living; but as the exporter wherever he dwells is subject to a general world-wide advance in prices, as much in Europe anyhow as in America, it would seem that the subjects are quite separate. Various reasons may be and are advanced specifically for relatively smaller exports, especially of articles of great quantity and bulk, such as food products. It is said that we have less food available for export, and some authorities predict that in a few years we won't have any. Another reason given is that we have educated our competitors, who no longer need our goods, but have their own to export, made with tools and apparatus of American design. Another complaint is against high tariffs, although, as we are a chief sinner, it is perhaps well to glide over that point. An obvious explanation is that many American manufacturers are increasing in size and number the plants they erect abroad. Then there are all kinds of subsidiary explanations, such as bad packing for shipment; lack of experience in exporting; poor methods and lack of patient continuity—many others also which have been touched upon by Dr. Crocker lately in his instructive articles in these pages.

Without trying to sum up this vast and important subject, we will descend to the more cheerful detail effects in noticing that meantime the electrical exports have generally maintained the upward trend now shown for some months past. The exports of electrical machinery for March reached the sum of

$699,261 as compared with $579,499 in March, 1909; while in electrical instruments and apparatus, the shipments were worth $783,371 as compared with $681,083 a year ago. The total is $1,482,632 as compared with $1,260,582, exhibiting a very respectable gain for the month. The improvement in shipments of heavy stuff seems to be slow, but apparently there is a steady gain in miscellaneous and smaller, more intrinsically valuable articles; and this might well be the course of our general development in foreign trade so long as we are satisfied with an average wheat production of less than 15 bushels per acre while a stolid Britisher or stodgy German gets away with 35 and is not stuck on himself. It is to be noted that the tide of immigration is flowing in again. Europe does not export anything to us in bulk except human flesh, and it might perhaps be wise to make more of that of the farming variety, if possible, and less that of the anarchistic, black-hand type.

THE NEBRASKA CONVENTION.

The convention of the Nebraska Electrical Association last week was profitable in suggestions for the central-station operators who gathered at Lincoln. This year the meeting was marked by the absence of exhibits or entertainments. While this might have made the convention seem rather slow to some accustomed to the lively pace set by meetings of similar bodies, the fact cannot be denied that the Nebraska convention certainly benefited in the way of full discussions of central-station matters. The absence of any electrical show or exhibit made the convention sessions the "only show" to be attended, the commercial men were in constant attendance at the sessions and their participation in discussions on points of central-station practice proved highly welcome. Without expressing an opinion on either side of this question, it is to be noted that the matter of elaborate exhibits seems to go in waves. The tendency each succeeding year is for more elaborate exhibits and entertainments at conventions, until these features cause so much trouble and expense to the manufacturers and detract so much from the convention sessions that a change is finally made to more simple methods.

Concrete poles are being experimented with in a small way by some Nebraska companies, and a very interesting sample of a concrete and steel-pole top was exhibited by one of the central-station men in the convention hall. From the figures given, it appears that for very tall poles reinforced concrete is cheaper than cedar, in Nebraska, the labor of setting being included. For shorter poles cedar is cheaper. The transportation and setting of heavy concrete poles is, of course, a considerable item. Ice plants operated from exhaust steam in connection with electric plants received a full discussion, one member of the association having successfully operated such a plant for over a year. As ice is coming to be as much of a necessity as electric service, and as there are notable economies in the addition of an ice-making plant to a central station, there is undoubtedly to be a large increase in the number of such combined plants during the next few years, for reasons which have been reviewed in these columns at length recently. The compilation of rates charged by 20 companies in towns of less than 5000 inhabitants forcibly illustrates how little consideration has apparently been given by small companies to the making of rates which correspond to the cost of production, and which are so arranged as to be competitive with gasoline and other illuminants. The common system of charging among small plants in Nebraska, as elsewhere, is a certain base rate per kw-hour, with discounts according to the quantity consumed, without any regard to the number of hours' use per month of the consumer's connected load. Such rates are neither suitable to meet competition nor to secure equitable division of the expenses among the different consumers. The two-rate system of charging, in which the consumer's discount depends on the number of hours use of the connected load, is likely to be required when State commissions become common, but it is apparently beyond the comprehension of many of the managers of small companies, principally for the reason that they have never given the matter the small amount of time necessary to understand it.

THE PERENNIAL LIGHTING STRUGGLE IN LONDON.

It is not unnatural that in a city so huge as London there should be many opportunities and many diversified efforts with respect to street lighting. Gas and electricity have been in a hand-to-hand, or eye-to-eye, struggle for some years past, a struggle reminding one in some respects of the duel between guns and armor upon warships. But while this latter difficulty has been apparently settled once for all in favor of the guns, there is still some doubt as to the result in the former case, so far at least as London conditions are concerned. The latest news is that the gas company has beaten out its rival in bids for the lighting of certain portions of Westminster. It is a victory which will probably be made much of in spite of the fact that the actual winnings were small, since the territory has been mostly lighted by gas and the only electric lamps affected are 71 arcs. The bids called for by the Westminster City Council were for gas and electric lighting in four separate districts, the lamps in each case to be of 90 cp, 180 cp, 300 cp, 1800 cp and 3000 cp each. The tenders were to include cost of installation for each of these units, and an annual maintenance and supply for 3940 hours per year during periods of 5, 10 and 15 years. As noted in the Digest the figures given in response to these tenders would indicate that the gas company was willing to lose a little money for the sake of glory and that the electric company, more cautious as to finances, has raised itself out of the game.

The matter of renewals in the more powerful gas lamps is one about which singularly little has been allowed to become public. Earlier experience with such lamps indicates that the mantles must be replaced very frequently in order to keep them anywhere near their rating. Observation upon mantle gas lamps in this country leads, for the smaller units, to precisely the same view. As a result it is safe to predict that if the undertakers in this case are held rigorously to their contract specification of candle-power, they will not have a very pleasant time of it and it is safe to say that the electric fraternity in London are quite active enough to see that their competitors are not allowed to escape their obligations. Meanwhile it is interesting to note that the major part of the electric lighting in the city of Westminster is being done at a good price under a contract which runs until 1931, by which time there will be plenty of experience in press-gas and ample opportunity for the improvement of the arcs. Upon the whole, therefore, we are not disposed to extend commiseration to the electric company that lost the particular contract which is here under discussion.

It looked, in fact, as though it had dexterously stepped aside and allowed their competitors to fall into a hole.

A PHYSIOLOGICAL EFFECT OF AN ALTERNATING MAGNETIC FIELD.

At last, after many non-successes, Prof. Silvanus P. Thompson has announced, as is mentioned in detail on page 1209, that physiological sensation or sensory disturbance has been produced by magnetism. In this case, the effect has been produced by a powerful alternating magnetic field. It is stated that a faint flickering illumination is produced, as a subjective physiological sensation, when the head is introduced into the interior of a coil of wire carrying a powerful alternating m.m.f. This experiment has been tried before, and in this country, without success, using a maximum cyclic flux-density up to some 700 gausses. It seems that success depends upon forcing the maximum cyclic magnetic flux density up to some 1400 gausses, which is a very considerable density to attain inside a large open coil. It is also stated that an effect has been noticed on the sense of taste. Now that the effect has been discovered, it should be possible to extend the enquiry along definite lines in order to locate the influence. The questions naturally suggest themselves as to whether the disturbance is produced in the retina, in the optic nerves, or in the brain. Is it affected by the frequency or by the wave-form of the alternating magnetic flux?

It was alleged, some 20 years ago, that there were certain individuals who were so organized that they could perceive, with the unaided eyes at a moderate distance, when an electromagnet was excited. A particularly sensitive individual claimed to be able to see a bluish halo, flame or emanation, rise above and around the poles of an electromagnet on its excitation, and maintained that he was able to declare in a dark room whether a powerful electromagnet at a distance of several meters from him was excited or not. The case was investigated at the time by Society for Psychical Research. The sensitive observer was placed in a dark room with the electromagnet. A second observer was placed in a distant room with the circuit-closing switch of the electromagnet. A third observer was placed at a station intermediate between the other two, so as to record, on the one hand, when the switch was opened and closed at purposely irregular intervals, and, on the other hand, when the sensitive observer saw or did not see the alleged emanation. After a long series of experiments, which at first were misleading, the possibility of seeing magnetism at a distance was finally announced to be not proven. Of course, the magnets referred to at that time were excited by unidirectional currents. Up to the present time, unidirectional magnetic flux has failed to produce any definitely recognizable sensation in human beings. There is, of course, more chance for alternating-magnetic flux on account of the range of possible frequencies to be explored, in addition to the range of possible flux-density. If, however, it takes about a kilogauss of flux-density through the head of an observer to make him detect any visible effect of magnetic flux, it does not seem likely, *à priori*, that workmen could see lights over choking coils carrying alternating currents, at any considerable distance from the same, unless they possessed extraordinary sensitiveness to such stimuli. A density of 1400 maximum cyclic gausses at 50 cycles per second would generate an alternating e.m.f. of the same frequency and nearly one-two-hundredth of a volt in a single centimeter of length of any substance in the most favorable direction, so that in the length of the optic nerve a respectable fraction of a volt would be generated thereby.

MAGNETIC PROPERTIES OF MATERIALS.

The article by Dr. Steinmetz, on page 1209 of this number, is a brief on behalf of the theory that magnetic alloys owe their ferro-magnetic properties to some particular ferro-magnetic constituent, or constituents, and that no ferro-magnetic alloy has yet been found to negative this theory by possessing only non-magnetic constituents. According to this view, the Heusler alloys are ferro-magnetic because they contain manganese, which is a metal in the ferro-magnetic group. Taken by itself, manganese is only very feebly ferro-magnetic, owing possibly to some physical disabling condition. This disability is somehow removed by, and in the presence of, the other constituents in the alloy. It does, in fact, appear that thus far every strongly ferro-magnetic metallic substance contains at least one of the metals iron, nickel, cobalt, manganese or chromium, which are in the ferro-magnetic group. The proposition that strongly magnetic alloys are capable of being produced from non-magnetic elements should thus be modified to read that strongly magnetic alloys are capable of being produced from seemingly non-magnetic elements if any of the ferro-magnetic elements are among them. The presence, therefore, of marked ferro-magnetic properties is not immediately dependent upon the molecule of the substance, although only certain kinds of molecules can at present be made to evince it. It depends upon some favorable grouping, arrangement or condition of these molecules. As is pointed out in the article, the Heusler alloy itself, when carefully annealed, is almost non-magnetic, but when suddenly chilled from incandescent temperature it acquires strong magnetic susceptibility. It is difficult to suppose that the chilling can alter the molecules. It is easy, on the other hand, to suppose that the chilling can alter the crystallization or grouping of the molecules.

Granting, then, the proposition set forth in Dr. Steinmetz's article, the fact remains that the Heusler alloys have largely contributed to modify our previous notions concerning the property of ferro-magnetism. It used to be considered an inherent, ineffacable and indestructible property of the atom, or molecule, of a ferro-magnetic substance. The property might be weakened or diluted by the admixture of non-magnetic molecules, or it might be strengthened by concentrating the iron molecules, and by annealing the mass, in order to liberate the individuals; but it existed to a definite and unalterable extent in each individual molecule. Gradually the phenomena of loss of magnetic susceptibility with incandescent temperature in iron, the tempering of steels, and notably the Heusler alloys have left us in the belief that although ferro-magnetic properties seem to require ferro-magnetic atoms, yet the susceptibility depends upon physical conditions rather than on chemical products. Moreover, the possibility is suggested that not only metals of the para-magnetic group, but also other metals may yet be aggregated or brought into a condition of magnetic susceptibility. The manganese-antimony powder, of which we have received a sample from Dr. Steinmetz, accompanying the article, is a black powder somewhat resembling crumbled plumbago in appearance and touch, without taste or odor, and presenting under the microscope very much the appearance of anthracite coal. It is strongly magnetic, and the particles align themselves in the presence of a magnetic field almost as strongly as do iron filings.

N. E. L. A. Convention.

Final arrangements have been made for the sessions of the convention of the National Electric Light Association, to be held in St. Louis, on May 23, 24, 25, 26 and 27. The first day, Monday, May 23, will be devoted to the registration of members and guests during the day and to a reception during the evening. On the other days will be held general, technical, commercial, accounting and executive sessions, as noted below.

GENERAL SESSIONS.

Tuesday, 10 *a. m.*—Welcome to St. Louis. (1) President's address. (2) Announcements. (3) Report of editor of Question Box, Mr. John C. Parker. (4) Report of editors on Question Box revision, Messrs. Paul Lüpke and Alex. J. Campbell. (5) Report of committee on progress, Mr. T. C. Martin. (6) Paper on "Super-Specialization," Mr. Paul Lüpke. (7) Report of committee on membership, Mr. H. H. Scott. (8) Report of official representative on the National Conservation Commission, Mr. Dudley Farrand.

Tuesday, 2:30 *p. m.*—(1) Report of lamp committee, W. F. Wells. (2) Paper on "Periodic Lamp Renewals," by Mr. A. G. Strickrott. (3) "Magnetic and Flaming Arc vs. Open and Enclosed Carbon Arcs for Street Illumination," by Mr. W. D'A. Ryan. (4) "New Form of Tungsten Lamp," by Mr. C. F. Scott. (5) "High-Efficiency Lamps," by Mr. S. E. Doane.

Wednesday, 8 *p. m.*—Anniversary meeting. (1) Paper, "Founding the Association," by Mr. E. A. Sperry. (2) Address, "Twenty-five Years of Central-Station Commercial Development," by Mr. Samuel Insull. (3) Report of public policy committee, by Mr. W. W. Freeman. (4) Election of nominating committee. (5) Report of secretary and treasurer.

Friday, 10 *a. m.*—(1) Report of committee on preservative treatment of poles and cross-arms, by Mr. W. K. Vanderpoel. (2) Report of committee on terminology, by Mr. W. H. Gardiner, Jr. (3) Report of insurance expert, by Mr. W. H. Blood, Jr. (4) Paper on "Decentralized Steam Plants," by Mr. R. D. DeWolf. (5) Memorials, by Mr. T. C. Martin. (6) Report of nominating committee. (7) Election of officers.

TECHNICAL SESSIONS.

Wednesday, 10 *a. m.*—(1) Report of overhead line construction committee, by Mr. Farley Osgood. (2) Paper on "Location of Faults in Underground Cables," by Mr. W. A. Durgin. (3) Paper on "A New Departure in Distribution Construction Methods," by Mr. S. B. Way. (4) Report on the grounding of secondaries, by Mr. W. H. Blood, Jr. (5) Paper on the "Use of the Oscillograph in Fuse Testing," by Mr. Alex. Maxwell.

Wednesday, 2:30 *p. m.*—(1) Report of meter committee, by Mr. G. A. Sawin. (2) Paper on "Space Economy of Turbo-Generators," by Mr. Paul H. Lincoln. (3) Paper on "Direct-Current Turbo-Generators," by Mr. W. L. Waters. (4) Report of gas-engine committee, by Mr. I. E. Moultrop. (5) Paper on "Gas-Engine Plant for Central Stations," by Mr. Nesbit Latta. (6) Paper on "Interesting Points About Modern Transformers," by Mr. E. G. Reed, Pittsburgh.

Thursday, 10 *a. m.—Transmission Session.*—(1) Paper on "Present Problems in Energy Transmission," by Mr. H. W. Buck. (2) Address on "The Public and the Water-Powers," by Mr. Henry L. Doherty. (3) Paper on "Phenomena of Transmission at Highest Voltages," by Dr. C. P. Steinmetz. (4) Paper on "Modern Transformers for Transmission Work," by Mr. K. C. Randall. (5) General discussion on organization and work of the Transmission Section.

Thursday, 2:30 *p. m.*—(1) Report of committee on protection from lightning and other static disturbances, by Mr. B. E. Morrow. (2) Paper on "Comparison of American and European Switchboard Practice," by Mr. Stephen Q. Hayes. (3) Paper on "Voltage Control of Generators and Feeder Systems," by Mr. F. W. Shackelford. (4) Paper on "Feeder Regulators," by Mr. E. E. Lehr. (5) Paper on "Water Intake from the Mississippi River for Two Electric Generating Stations in St. Louis," by Mr. John Hunter. (6) Paper on "Precautions When Using Instrument Transformers," by Mr. L. T. Robinson.

COMMERCIAL SESSIONS.

Wednesday, 10 *a. m.*—(1) Paper on "Latitude of Commercialism," by Mr. Arthur S. Huey. (2) Paper on "Residence Lighting," by Mr. H. J. Gille.

Wednesday, 2:30 *p. m.*—(1) Paper on "Advertising," by Messrs. H. K. Mohr and C. W. Lee. (2) Paper on "Automobiles," by Mr. Hayden Eames. (3) Paper on "Ornamental Street Lighting," by Mr. E. L. Elliott.

Thursday, 10 *a. m.*—(1) Paper on "Sales Department Organization," by Mr. T. I. Jones. (2) Paper on "A Plan to Interest National Advertisers in Electric Publicity," by Mr. Frank B. Rae, Jr. (3) Paper on "Industrial Lighting with Incandescent Lamps," by Messrs. S. H. Hall, J. M. Hoit and Paul Bauder. (4) Paper on "Prompt Execution of Orders," by Mr. C. N. Stannard. (5) Paper on "Electricity on the Farm," by Mr. Herman Russell.

ACCOUNTING SESSIONS.

Wednesday, 10 *a. m.*—(1) Report of committee on uniform accounting, by Mr. John L. Bailey. (2) Paper on "Accounting Methods as Applied to Detroit Properties," by Mr. E. J. Bowers. (3) Paper on "Care and Handling of Customers' Accounts," by Mr. J. M. Mulvihill. (4) Paper on "Storeroom Accounting," by Mr. R. F. Pack.

Wednesday, 2:30 *p. m.*—(1) Paper on "Significance of Statistics," by Messrs. George A. McKana and B. F. Maguire. (2) Paper on "Classification of Income and Sales," by Mr. W. W. Dow. (3) Paper on "Job or Work Order System," by Mr. R. D. Rubright.

THE TRANSMISSION SECTION.

A new departure in the work of the association is represented in the formation of the Transmission Section, of which Mr. D. B. Rushmore is chairman. As will be noted from the above, one of the sessions will be devoted to the subject of the transmission of energy, and a formal organization of the section will be effected at the convention. A committee on constitution and by-laws, with Mr. B. E. Morrow as chairman, has been appointed, and will report at that time. A committee on membership, with Mr. J. F. Vaughan as chairman, has already begun active work. A number of other committees will also report at the convention.

The Transmission Section is to be primarily an organization of operating companies, and with it are to be associated manufacturers of electrical and other apparatus used in transmission work, consulting engineers and individuals interested in this field. The objects of the organization will be to bring all of the transmission companies together to work for their mutual welfare, to allow them opportunity for exchange of experience, for the promotion of objects common to all, and to develop the art in the best possible manner. The standardization of practice will necessarily be one of the results early brought about, and in general such an organization will be expected to do for transmission work what has already been done for lighting and electric railway work. It is thought that this organization will not in any way conflict with the excellent work which has been done by the American Institute of Electrical Engineers, but rather will be supplementary to it.

For the last three or four years there has been a considerable discussion regarding the formation of a separate national society devoted to the interest of transmission, because the field of transmission work by itself has been largely a separate field, and its problems have been more or less distinct from those of any other class of work. To-day, however, the transmission of energy is very closely associated with the same interests which distribute and retail the energy for lighting, industrial or railway applications, and to a considerable extent transmission systems are becoming high-voltage distributing systems, very often under the same operating organization as the lighting companies. On the other hand, as the lighting systems have grown, the voltage used and the distances covered have brought them into a field which not long ago was considered distinctly that for a transmission system. The common interest brought about in this way has made it seem desirable to form the trans-

mission section of the National Electric Light Association, rather than to start an entirely separate organization.

TRANSPORTATION.

As noted in a previous issue a special convention train will be run to St. Louis to convey the New York, New Jersey and New England delegates. This train will leave New York City by way of the New York Central on Sunday, May 22, at 2:45 p. m. and will arrive in St. Louis at 2 p. m. on Monday. This train will be first-class in every particular, carrying observation, buffet and diner, and will pick up the Schenectady, Rochester and Buffalo delegations en route. The New England delegation will leave the South Terminal, Boston, on Sunday, in special cars attached to the 11:30 a. m. train by way of the Boston & Albany Division of the New York Central Lines, due at Albany at 5:25 p. m., where connections will be made with the special convention train from New York City.

The Pennsylvania Railroad Company has also arranged for a special convention train which will leave Jersey City at 11:14 a. m. on Sunday; Philadelphia, 1:10 p. m.; Pittsburgh, 9:45 p. m.; Indianapolis, 7 a. m., and arrive in St. Louis at 1:25 p. m. on Monday. The train will consist of Pullman parlor smoking car, dining car, drawing and stateroom sleeping cars, and stateroom observation car.

Ductile Tungsten.

In a paper presented last week before the American Electrochemical Society, Dr. Colin G. Fink, of the Research Laboratory at Schenectady, New York, gave some very interesting information relating to production of ductile tungsten at that laboratory, announcement of which appeared in these columns several weeks ago. The paper also treats of ductile molybdenum, the title being "Ductile Tungsten and Molybdenum."

The author states that tungsten, which has the highest melting point of any metal (3000 deg. C.) has ordinarily been obtained in commerce in the form of a dark gray powder, usually from the reduction of the oxide by hydrogen or by carbon. As obtained in the open market, this powder is generally impure, and is purified by various well-known methods, particularly if the metal is to be used for filaments for incandescent lamps. It is stated, however, that even in ordinary commercial lamps the tungsten filaments are of a degree of purity so high that no impurities can be discovered by the most searching methods known to chemical analysis; moreover, the filaments during the course of commercial production are exposed to temperatures high enough to drive out by mere vaporization almost any conceivable impurity. Nevertheless, such filaments show no traces whatever of ductility or even pliability, but, on the contrary, though strong enough for mounting in commercial lamps, they are exceedingly brittle and incapable of taking a permanent set.

The paper sketches the attempts hitherto made to produce ductile tungsten by various purification processes, and all without success, and it had generally been concluded that the metal is entirely lacking in that physical property which is ordinarily called ductility. The result of the work at Schenectady has been the production of tungsten in a form in which it is ductile and which, it is stated, would seem to be a new substance from the point of view of the physical chemist. The material is a bright, tough, steel-colored metal, which can be drawn into the finest wire, much below one-thousandth of an inch. The tensile strength of the wire increases as the drawing proceeds, or, in other words, the more the metal is mechanically worked the tougher it gets. A table included in the paper gives a tensile strength varying from 490,000 lb. per square inch for a wire 0.005 in. in diameter to 610,000 lb. for a diameter of 0.0012 in. The tensile strengths found for molybdenum wire varied from 260,000 lb. per square inch for a wire 0.005 in. in diameter to 310,000 lb. for a wire 0.0015 in. in diameter. A piece of hard-drawn piano wire, tested with the same apparatus, registered, on the average, 507,000 lb. per square inch, the diameter of the wire being 0.003 in.

The density or specific gravity of ductile tungsten increases similarly with the amount of working, varying from a value of 18.81 before drawing to 20.19 for a wire 0.0015 in. in diameter. The corresponding values for molybdenum are 10.02 and 10.32.

A table in the paper gives the electrical resistance and the temperature coefficient of the two metals, which were obtained by the Wheatstone bridge method, the resistance being measured at room temperature and at 170 deg., employing two oil thermostats. The resistivity for tungsten was found to be 6.12 for hard-drawn wire and 5 for annealed wire, the corresponding figures for molybdenum being 5.6 and 4.8. The resistivity of copper is 1.59. The temperature coefficient of the former, is between 0 deg. and 170 deg., 0.0091, and of the latter, 0.0050. The coefficient for copper is 0.0045.

Chemically, the two ductile metals are stated to behave similarly in most respects. The drawn wire retains its luster almost indefinitely. Both metals are readily attacked by fused oxidizing salts, such as sodium nitrate, potassium bisulphate and sodium peroxide. Acids, such as hydrochloric, nitric and sulphuric, attack tungsten very slowly, but molybdenum rather steadily. Fine-drawn tungsten, when heated in a mixture of chromic and sulphuric acid for 16 hours, shows only a very small loss in weight.

In concluding the paper Dr. Fink states that in the work to which it relates, which was carried out at the Research Laboratory of the General Electric Company, at Schenectady, a number of chemists and research men participated, foremost among whom was Dr. Coolidge.

Report of the New Jersey Public Service Corporation.

The Public Service Corporation of New Jersey has issued in pamphlet form its first annual report, which is of particular interest through giving an account of the development of the corporation and other information of a general character not usually included in such reports. A list too long for reproduction here is given of the electric light, railway and gas companies controlled by the corporation, and of the municipalities served from its plants. These latter consist of 27 cities and towns in the Essex Division, 14 in the Hudson Division, 9 in the Passaic Division, 43 in the Bergen Division, 37 in the Central Division and 46 in the Southern Division, a total of 176. Of this total 146 are supplied with electric light, 125 with gas and 101 with electric traction service. The total number of employees is approximately 10,000.

The basic rate for electric lighting over the entire territory is 10 cents per kw-hour. The corporation has purchased land, and has commenced work on the foundations for a new electric generating station at Perth Amboy. The generating station at Marion, on the banks of the Hackensack River, has at the present time a total capacity of 40,000 kw, which will ultimately be increased to 100,000 kw. The total length of the transmission lines is 340 miles and of street conduit 74 miles. The total number of line poles is 90,748. There were 11,476 transformers in service and 54,108 meters, the total number of consumers being 53,900. The number of street arc lamps supplied was 10,863, and of street incandescent lamps 15,175. The total commercial load connected was, in 50-watt lamp equivalents, 2,242,226 lamps. The total sales in kw-hours for electric lighting were 78,911,840. The total connected load Dec. 31 was 118,138 kw.

The total outstanding funded debt of the Public Service Corporation and its controlled companies is $160,917,433, to which should be added total miscellaneous obligations of $1,091,500. The gross earnings for 1909 were $26,560,451; operating expenses and taxes, $13,331,228, leaving a balance of $13,229,222. Bond interest and rentals of leased and controlled companies aggregated $10,111,403, leaving a balance of $3,117,819. The fixed charges of the Public Service Corporation were $1,689,371, leaving a surplus for the year of $1,428,447. Dividends were paid for the first two quarters of the year at the rate of 4 per cent per annum, and for the last two quarters at the rate of 5 per cent. The gross earnings of the corporation from electric lighting were $5,117,728; from gas, $7,870,878; from electric traction, $12,114,412. The total taxes paid during 1909 were $1,225,582.

National District Heating Association Convention.

Following is the program of the convention of the National District Heating Association, to be held at the Boody House, Toledo, June 1, 2 and 3:

The first session, Wednesday, June 1, an address of welcome by the Mayor of Toledo, response by Mr. D. J. Hard, of Cleveland, and the presidential address by Mr. A. C. Rogers.

On Wednesday afternoon, a paper will be presented by Mr. W. A. Wolls, of the Columbus Railway & Light Company, on "A Modern Central Hot-Water Heating Station," and another on "Central-Station Heating in Detroit," by Mr. A. D. Spencer, superintendent meter department, Central Heating Company, Detroit, Mich. On Thursday morning there will be a lecture by Dr. W. W. Brand, health officer of Toledo, Ohio, on "Humidity: Its Necessity and Benefits."

On Thursday afternoon, the following papers will be presented: "A Study on Insulation"; "A Study in Centralizing Heat Supply," by Prof. J. D. Hoffman, of Purdue University. Also, a discussion on "The Advantages to be Derived from the Combination of Heating and Power Business for the Central Station," to be opened by Mr. R. D. DeWolf, of the Rochester Railway & Light Company, of Rochester, N. Y. On Friday morning Mr. Byron T. Gifford, of Chicago, will present a paper on "The Profitable Operation of a Central Station Without the Assistance of Electrical or Other Industries," and Mr. Charles R. Bishop, of Lockport, N. Y., one with the title, "The Factors That Enter into the Cost of Generating and Distributing Steam for Heating." On Friday afternoon there will be a paper on "The Relative Efficiency and Resistance to Corrosion of Different Types of Radiators," and a lecture on "Coal Production and Consumption," by Prof. R. H. Fernald, of the U. S. Geological Survey and Case School of Applied Science, Cleveland. Mr. D. L. Gaskill, Greenville, Ohio, is secretary of the association.

Insulating Materials for Wireless Telegraphy.

At a meeting of the Wireless Institute, held at the Engineering Societies Building, New York, on May 4, Mr. Stanley M. Hills read a paper dealing with materials for resisting dielectric stress, mechanical rupture, flow of electricity and heat, and the action of chemicals. He gave an outline of the electrical, mechanical and chemical characteristics of air, oil, marble, hard-rubber, porcelain, glass, paper, mica, wood, lava and various compositions. He stated that where the distance is not limited dry air forms a good insulator, and compressed air can be used where high voltages are encountered. Dry oil makes an excellent insulator on account of its self-healing properties. Hard-rubber is apt to deteriorate with age. Marble is hydroscopic and irregular in mechanical characteristics. Porcelain is surprisingly strong mechanically, but is apt to possess unknown defects. Glass is very fragile, but its defects are visible upon superficial examination. Mica is extremely good for localities where oil or moisture will not be encountered. Wood is a good insulator when kept perfectly dry and has good mechanical properties.

Mr. R. H. Marriott remarked that hard-rubber and wood are frequently used for strain insulators in the guys for wireless masts. Oak has proved good for this purpose. In some of the early stations use was made of rope for strain insulators. Porcelain compression insulators have many excellent characteristics for wireless installations.

Mr. A. N. Goldsmith described the use of an insulating material of lava which can be molded into any desired shape and then baked to form an insulator possessing excellent electrical, mechanical and chemical properties.

Mr. J. J. Frank mentioned the fact that moisture is detrimental to the performance of practically all insulators. A very small percentage of moisture greatly lowers the insulating strength of oil. Solid insulators can be kept free from moisture by maintaining them at a temperature higher than their surroundings or blowing warm, dry air across them.

Electrification Discussion at Boston.

The former chairman of the Massachusetts Railroad Commission, Mr. James F. Jackson, appeared before the legislative committee on metropolitan affairs on May 5 and argued in behalf of the passage of a resolution directing the railroad companies within the Boston district to prosecute studies with reference to electrification. He stated that no one can doubt the power of the Legislature to compel the railroad companies to operate their lines so as to promote the public health and comfort, and pointed out that while electrification is a large problem there is no reason for a timidity that would prevent all action on the matter and turn the whole question over to the procrastination of the railroads. The smoke and cinders which pour from locomotives over travelers and into residences in this densely settled territory are destroying property and comfort and menacing health. Beyond that, electric power itself means not only clean but a frequent and enjoyable service.

Mr. Jackson emphasized the large sums which have been expended at New York in electrifying railroad lines, and that this came about, not by voluntary action by the companies, but in obedience to the command of the Legislature, although when a beginning was made both the New York Central and the New Haven systems entered into the work with most commendable enterprise. He stated that the petitioners are not insisting that railroads in Massachusetts be electrified merely because railroads have been electrified in New York, but that they do demand immediate attention to an imperative need for relief and immediate steps to secure to Boston and to Massachusetts a fair share in the blessings which modern methods make possible as soon as they can reasonably be provided. The initial impulse is essential at this time, and the Legislature alone can give that.

In closing Mr. Jackson said that the petitioners for electrification practically ask the Legislature to inspire the energy and enterprise which are already awake with a permanent purpose and to arouse an interest in the change in quarters where no evidence of such interest has yet appeared. The measure suggested is broad and just, and provides for an authority in the proper State board over the order and manner in which the work of electrification is prosecuted that will effectually prevent injustice to investment or stockholding interests. People are intensely in earnest about this matter and will not be content with the gentle suggestion that is found in the resolution submitted to the committee by the joint board.

Depreciation and Reserve Funds.

A representative audience of electrical men gathered at the rooms of the Western Society of Engineers in Chicago on April 27 to attend a joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers. The speaker was Mr. William B. Jackson, consulting engineer, Chicago, and his subject was "Depreciation and Reserve Funds of Electrical Properties."

In reading his carefully prepared paper, Mr. Jackson explained that he was giving his ideas of the general principles involved in considering the matter of depreciation; he did not contend that these general principles are of invariable application in each case; in setting aside funds for depreciation, for instance, it is necessary to take into account the lean as well as the fat years.

With a properly conducted property the fact that the property has suffered depreciation should not have the effect of injuring the quality of its service or of impairing its capital, which would be the case if its recognized earning capacity were expected to decline proportionally with the increase of its depreciation fund. If a fair figure has been estimated for the annual contribution to the depreciation fund, this fund will always carry sufficient money to make replacements when required, and since the income from the depreciation fund is

used to help build the fund, the owners of the property will not receive returns on their money twice.

The author considered depreciation under two heads, namely, decrepitude and obsolescence. The former covers the gradual wearing out of the apparatus from the effects of use and of age; it cannot be overcome by current repairs, and results eventually in ending the operative life of the apparatus. The latter takes into account the reduction in the useful life of the apparatus on account of advances in the art whereby otherwise operative apparatus is made uneconomical for further use. The expenses involved in meeting depreciation are as real as the pay-roll and other daily operating expenses of a plant, but the ravages of depreciation frequently do not show to a noticeable degree until several years after the beginning of the operation of a plant, and there are also likely to be long periods during which it is unnecessary to make much, if any, outlay on account of required reconstruction and special insurance. For these reasons there is serious danger of overlooking the importance of these expenses in promoting a new enterprise, or in the early days of the operation of a public-service company. But if the earnings of a company, after it has become well settled in its business, are not sufficient to cover a fair appropriation annually to the depreciation and reserve funds, as well as to cover the regular operating expenses and a reasonable return on the investment, that company is one that conservative investors should shun. If the conservatively estimated earnings of a new project do not show that they will provide such returns, it should not be considered an attractive project.

A good discussion followed the reading of the paper. Mr. Wray referred to the importance of the subject, and to the fact that only within very recent years has scientific study been given to it. He introduced Mr. C. N. Duffy, who recited some of the experiences of the Milwaukee Electric Railway & Light Company both before and after the creation of the Wisconsin State Commission, where the subject of depreciation was discussed during efforts made by the city to secure reduced fares. Mr. Duffy contended that a depreciated property does not mean a diminished investment. His company's experience has been that maintenance does not take care of depreciation. However, there are practical difficulties in setting aside a regular sinking fund to cover depreciation. The Milwaukee company has not an invested depreciation fund; it prefers the "straight-line" plan to the sinking-fund plan. Mr. Duffy referred to one decision of the Wisconsin commission, in which the depreciation period of an electric-light plant was placed at 18 years and the corresponding period of a gas plant at 30 years.

Mr. Wray explained the benefit of the "straight-line" plan where, as is often the case, provision is made in the ordinance that the property may be purchased by the city at certain fixed times.

Mr. George Weston, a member of the Board of supervising Engineers, Chicago Traction, was called on as a representative of a public-service commission. Mr. Weston said the question under discussion is really a financial one. Depreciation funds are very desirable; the amount which can be set aside depends on the relation of fixed charges to gross income. In the Chicago street-railway ordinances, it has been assumed that a net reserve of 14 per cent—6 per cent for maintenance and 8 per cent for depreciation—is sufficient.

Mr. C. N. Uebelacker, chief engineer of Ford, Bacon & Davis, New York, was one of the speakers who rather decried excessive apprehension in studying the depreciation problem. There are several ways of figuring depreciation, he said. For instance, it is for the stockholders to say whether the payments set aside for this purpose shall be returned to them from time to time, or in a lump sum at the end of a fixed period. Mr. Uebelacker used the term "supersession" a good deal; it is a very uncertain thing to figure, he said. Why build up big funds for the superseding of apparatus until the event actually takes place? This remark applies more especially to a growing concern. Will not the new apparatus going in from time to time earn sufficiently more money to make up the cost of the renewal? Why not let the man who gets the improved service pay for it?

Mr. E. J. Fowler, statistician of the Commonwealth Edison Company, Chicago, said that there are about as many methods of keeping track of depreciation in the electric-light business as there are different kinds of rates for service. The subject is one which must be studied more carefully. Possibly the problem is not so serious as has been imagined. Consider, for instance, appreciation of real estate, interest on funds set aside for depreciation, salvage from replaced apparatus, etc. The average rate of depreciation, when these allowances are made, may not be so large as many have supposed. Further, many companies may have taken care of their depreciation without any careful system. Nevertheless, a system of calculating and providing for depreciation is a good thing. What Mr. Jackson in his paper describes as "decrepitude" has no doubt taken care of depreciation in many cases by maintenance charges.

Mr. Harold Almert, of H. M. Byllesby & Company, Chicago, alluded to the difficulties of the small companies in endeavoring to get at the bottom of this question. He argued for keeping up the rates for service, in view of the great increase in the cost of labor and material in recent years. He cited a case where a company had actually spent $5,000,000 in capital investment, but when an examination of the property was made from an outside source, it was discovered that the value of the physical equipment was about $1,200,000. This state of affairs was due to various consolidations and absorptions, resulting from a number of competing companies in one community. A more careful study of the subject of depreciation should be made.

Mr. John S. Allen, manager of the Equitable Electric Light Company, of Lake Geneva, Wis., commented on the point of refinement to which the study of depreciation has been carried by public-utility companies. No other business goes so far in providing for this charge; public-service companies are struggling against great odds. Grocers are not required to make a uniform profit on all classes of their goods. Why should public-service commissions lay down regulations for the companies which practically require the latter to comply with restrictions which the grocer is free to disregard?

A written contribution to the discussion was received from Mr. F. H. Reed, editor of *Telephony*, and read by Mr. S. R. Edwards. The writer considered depreciation from the telephone manager's point of view. He remarked that maintenance holds up the plant, while the depreciation fund protects the investment.

Mr. G. W. Cravens said that the question is one of bookkeeping. He defined the terms, "maintenance," "depreciation" and "amortization." He believes that a sort of sliding scale should be followed in setting aside for depreciation, instead of providing the amount in equal annual sums. This plan gives a book value more nearly equal to the actual physical value of the plant at any time.

Mr. J. R. Cravath spoke of the difficulty in drawing a line between maintenance and depreciation. It is a matter of bookkeeping, he thinks, and it makes a good deal of difference who is keeping the books.

Mr. Weston remarked that maintenance should provide for ordinary repairs and depreciation for renewals of considerable portions of the equipment.

Mr. T. Milton, engineer in the Chicago office of the Electric Storage Battery Company, said a good deal depends on the definitions of the terms employed. The storage-battery people assert that there is really no depreciation on their product. The battery must be kept up by occasionally replacing plates in order to perform its work. This is obviously maintenance, and yet by continuing it, the battery may be maintained indefinitely. Therefore, is it not true that there is no depreciation on a storage battery?

Mr. E. N. Lake, division engineer for the Board of Supervising Engineers, spoke of the matter of providing reserve funds to meet the claims of the stockholders at a time of possible future sale, so often provided in modern ordinances. Is it possible to devise a theory of probabilities by which one may figure what the future City Council may consider a fair return at that distant date?

Several speakers, including Mr. Weston, Mr. Almert and Mr. Shoemaker, took issue with Mr. Uebelacker, who had questioned the necessity of providing a depreciation fund. Mr. Uebelacker defended his position, although he explained that he was seeking light on the subject, and that he had still to find answers to several questions that had been raised in his mind in relation to the complicated problem.

Others who spoke briefly were Mr. R. W. Pope, of New York, secretary of the American Institute of Electrical Engineers; Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company; Mr. George H. Lukes, general superintendent of the North Shore Electric Company, and Mr. A. W. Stager, of the Sanitary District.

In closing, Mr. Jackson said that if the public-service company sets aside a fair amount of reserve, it can go before the public-utility commission intelligently in asking for fair rates. Some companies do not get proper rates, because they do not know what depreciation means. The question is more than one of mere bookkeeping; it is one of the most important financial questions involved in the practical operation of public utilities.

The Nebraska Electrical Association Convention.

The convention of the Nebraska Electrical Association was held at the Lindell Hotel, Lincoln, Neb., May 3, 4 and 5, 1910. All the sessions were presided over by President B. C. Adams, of Lincoln. The first session was called to order about 10:30 a. m. May 3, when Mayor Don L. Love gave an address of welcome to the convention. In the course of his remarks he compared the Lincoln municipal pumping plant with the privately owned water company at Omaha, which pumps Missouri River water without treatment or filtration. The rate in Omaha he gave at 35 cents per 1000 gal., and the city pays $100,000 per year for fire hydrants. The Lincoln plant furnishes water to private consumers for 15 cents per 1000 gal., gives free public service and is laying aside $30,000 per year over expenses. Mr. W. J. Scoutt, of Kearney, answered the Mayor's address of welcome and said that members from the rural district have a feeling of pride in the capital city of the State, even though it is not their own city. President Adams in referring to the municipal-plant figures in the Mayor's address said that the city had no accurate way of separating its electric and water plant costs.

In his presidential address, Mr. Adams referred to the Municipal League recently organized. This, he said, seems to be favoring municipal ownership so strongly that it is doubtful whether the members will really try to get at the facts. Many plants in Nebraska are operated in connection with other industries, such as mills, and in some cases the other industries are helping carry the electric plant. He referred to the condition of affairs at David City, where the town has voted bonds to build a plant in competition with the company there, but cannot sell the bonds. He pointed out that if Nebraska had a public-service commission law like some other States, municipal plants would have to report on the same forms as private plants, and would have to maintain a uniform system of bookkeeping. This would take away some of the apparent profits reported on municipal plants. In connection with the Mayor's address and his remarks on the water situation in Lincoln as compared to Omaha, President Adams said he found on inquiry from some of the members that the Omaha water rate is from 35 cents to 6 cents per 1000 gal. according to quantity used. He, therefore, thought it quite likely that the average rate received for water in Omaha was far below the Lincoln rate, although the rate to small consumers in Lincoln was lower.

Tuesday afternoon Mr. Heywood Cochran, of the Carbondale Machine Company, Chicago office, read a paper on "Exhaust-Steam Ice Making." This paper showed how it is now possible for central-station companies having exhaust steam to utilize this by-product for ice making at a very slight increase of operating expense and so increase the returns of the investment. At the close of this paper, Mr. Cochran was asked many questions, and the discussion was so extended that there is no question of the interest of central-station men in this allied industry.

A short paper by Mr. Joel Roberts, of Yorks, Neb., on "Tungsten Lamps" was next on the program, and was read by the secretary, Mr. Frank McMaster. This contained answers to a list of questions from 10 central stations, giving the practice of these companies on various points. This was followed by an extended discussion.

At the end of this discussion there was some further informal discussion of the agitation for municipal plants which seems to be taking place in a number of towns in Nebraska. Mr. Frank McMaster, of Beatrice, said that Beatrice had called a special election to vote on issuing $70,000 bonds to add to the existing water-works plant and to put in an electric plant. There is some question whether this amount can be legally voted to extend an already existing plant, and also if the bond issue is favorably voted upon, whether the city can dispose of its bonds for the reason that Beatrice in years past repudiated one bond issue. At David City Mr. Bell reported that there is also agitation for a municipal plant. His company had offered to sell its plant to the city, but the city would not arbitrate the matter. According to some of the members there are unscrupulous so-called engineers working in various Nebraska towns stirring up municipal ownership sentiment in order to get the work of installing a plant, and usually give a figure for which a plant can be installed that is much less money than it will actually cost. Apparently there is in Nebraska much more municipal sentiment than in other States.

Wednesday morning session was opened with a paper by Mr. C. A. Snider, of Auburn, Neb., on "Concrete-Pole Construction." Mr. Snider had a sample of a concrete-pole top complete with cross-arms and pins erected in the convention room. This had galvanized-iron, angle-iron cross-arms, and also galvanized-iron brackets. For lengths over 35 ft. the concrete pole he had found cheaper than cedar poles. For shorter lengths the cedar pole is cheaper. The paper by Mr. Snider was followed by a long discussion in which various members gave some very interesting figures on the cost of pole lines.

Mr. G. S. Sprague, of Geneva, Neb., then presented a paper on "Power-Plant Reports," in which he urged the necessity of keeping regular records of power-plant performance in order to secure economy. He had collected power-plant records from a number of plants, which showed coal consumed per kw-hour from 7 lb. to 14 lb. Another paper along the same line was that of Mr. N. A. Kemmish, of Lincoln, on "Power-Plant Operation." He emphasized especially the necessity of inspection at regular intervals of all parts of the apparatus, rather than allowing it to go until its misbehavior demanded attention. He also made a number of practical specific suggestions for improvement of power-plant conditions, and showed where to look for waste.

Wednesday afternoon Mr. W. J. Scoutt, of Kearney, presented at the request of the president an analysis which he had made of the Lincoln city water works by the city auditor. This was done on account of the statements of the Mayor in his address of welcome the previous day, as to the amount of money being made by the Lincoln Water Works. Mr. Scoutt's analysis did not show any such surplus as stated by the Mayor. He stated that there is no possible way of figuring which would give a surplus of $30,000 in the operation of the plant after furnishing free of charge all water supplied for city purposes. He incidentally showed from the city's report on the lighting department that the cost per kw-hour generated to the city was 5.9 cents. He remarked that this cost of about 6 cents per kw-hour generated is more than 25 per cent in excess of the average total collections for light and power in the Kearney plant, which he represented.

Dean C. R. Richards, of the University of Nebraska, gave an address on the Engineering School, taking up the necessity for engineering of various kinds and concluding with a specific reference to the engineering school of the University of Nebraska. The electrical engineering course was started in

1888 by Prof. R. B. Owens. He noted with pride two eminent engineers which have come from the University of Nebraska, Messrs. Bion J. Arnold and J. G. White. He described the courses in engineering and some of the recent apparatus, among which should be named a steam-turbine set and a gas-engine and producer set for use with either hard or soft coal. President Adams at the close of this address said that the Doherty companies had a school for apprentices in central-station work at Denver, where 30 to 40 technical graduates are taken each year. After training they are distributed to various companies according to their needs. Mr. Adams also commented on the fact that he had once asked Mayor Love how many technical graduates were employed by the Lincoln Municipal plant. The Mayor answered none, with some regret. Mr. Adams then told him why such men did not seek employment with municipal plants. There is no inducement for ambitious men to enter municipal service.

The president then introduced Mr. Harry Glass, of Pittsburg, who read a portion of a paper prepared for the association by Mr. S. A. Fletcher. Mr. Glass also read extracts from a paper which he presented at the Iowa convention at Sioux City in April.

Mr. Harry Glass then presented the advantages of membership in the National Electric Light Association in a very convincing manner, Mr. Glass having volunteered his services for this purpose at such State conventions as could not be covered by one of the officers of the association. Mr. J. D. A. Cross, of the General Electric Company heating department, was called upon to make a few remarks on heating apparatus and the building up of heating load.

After the adjournment of the Wednesday afternoon session a special car was in waiting by courtesy of the Lincoln Traction Company to take the members of the convention to visit the power plant of the Lincoln Traction Company, and later the power plant of the Lincoln Gas & Electric Light Company.

Thursday morning Mr. E. C. Hurd, engineer of the Nebraska Railroad Commission, made a short address on the subject of public service commissions. This was followed by a long discussion, the general tone of which was favorable to the commission idea.

A paper by Mr. H. A. Holdridge, of Omaha, outlined the system of distribution for electric light and power which he considered best suited to the ordinary small town. This contained many good suggestions for the small companies and was based on standard practice of the larger companies which have had the benefit of much experience.

Mr. E. A. Bullock, of Norfolk, made a brief report on the Iowa convention, which he attended. He complimented the Iowa association as having some of the brightest men in the central-station business. Nevertheless he said he felt strongly that the plan upon which the Nebraska convention had been conducted was much better. At the Iowa convention an electrical show was held in the same Auditorium with the convention, and the meetings of the convention took place on the stage of this auditorium. Mr. Bullock said that he was opposed to having this exhibit feature at a convention. He preferred the plan of having no exhibits whatever, which had been followed at the present Nebraska convention. At the Iowa convention as a result of the exhibits almost no representatives of manufacturing and supply companies were found sitting in the convention, being kept away supposedly by the necessity of attending to their exhibits. In the 15 years that he had been engaged in the central-station business the largest single factor in his personal education in that business had been the information he had obtained from the traveling salesmen of electrical companies, who were able to tell him as to the practice of other central stations on various points. He thought that the salesmen made a mistake when they brought an exhibit of motors and other things to a convention and stayed by the exhibit instead of staying by the meetings. At the present convention the supply men had been present and had taken part in the various meetings, where their advice was welcome. The place for the supply men is in the convention sessions. He felt very strongly that the method pursued at the present convention was the best one. He did not favor any kind of "side show" in connection with the convention, as it simply detracted from the value of the meetings. If he had anything to say as to the manner of conducting the next convention, it would be against any kind of a side-show feature.

Mr. Bullock then severely criticised Mayor Love for his remarks in his address of welcome the first day of the convention. He considered them in the nature of an insult to the members of the convention, because of the odious comparison drawn between municipal and company management of a public-service enterprise. Mr. Bullock's remarks on this subject attracted much comment, both among those in attendance at the convention and in the daily press. It was explained later that the Mayor's reference to the city water works is one of his regular texts which has been used before nearly every convention assembling in Lincoln recently, and while the Mayor undoubtedly used bad taste in referring to the matter as he did before a convention composed very largely of managers of public-service corporations, no insult was intended.

Mr. B. L. Smith, of Nelson, Neb., read a short paper on "Rates for Cities of Less than 5000 Inhabitants." He had figures from 20 such stations, the average maximum rate of which was 14.5 cents per kw-hour. All of the companies on meter basis had discounts according to quantity. This was discussed at length. Mr. Otto Mellat, of the Lincoln Gas & Electric Company, read a paper on "Meters for Electric Light and Power." He described the various types of meters in use and the methods of testing. He favors testing all new meters before they are put up.

Mr. H. A. Holdridge, of Omaha, chairman of the committee on National Electric Light Association membership, made a report in which he did not favor any action toward making the Nebraska Electrical Association a section of the National Electric Light Association, but urged very strongly that all members of the Nebraska Electrical Association join the National Electric Light Association.

The nominating committee's report resulted in the election of the following officers for next year, most of whom are present officers: President, Mr. B. C. Adams, of Lincoln; vice-president, Mr. F. H. Brooks, of Lincoln; secretary and treasurer, Mr. Frank McMaster, of Beatrice. Executive committee: Messrs. E. A. Bullock, of Norfolk; B. P. Egan, of Nebraska City, and W. J. Scoutt, of Kearney.

Pittsburgh Meeting of the American Electrochemical Society.

The seventeenth general meeting of the American Electrochemical Society, held at Pittsburgh from May 4 to 7, was by far the best attended and best organized of the many successful meetings held by the society. The society was royally entertained by the city of Pittsburgh, not only by the local members, but by the whole of Pittsburgh, as was evidenced by the hearty and courteous welcome extended by the foremost engineers and public men of the place, by the remarkable interest shown in the meeting by the local daily press, and by the wide-open doors of all the principal industrial establishments of the city and vicinity. The chairman of the executive committee of the Pittsburgh local committees was Mr. Charles F. Scott; Messrs. F. Crabtree, H. K. Hitchcock, P. Kemery, H. H. Laughlin, R. S. Orr, H. Rodman and S. S. Wales were the other members of the executive committee. The attendance reached almost the 500 mark.

Probably the most attractive and immensely successful feature of the convention was the long series of visits and excursions which extended over two afternoons and one whole day.

On Wednesday afternoon the United States Geological Survey Testing Station was visited and a series of carefully prepared experiments and tests were shown to the visitors. These included the condition of explosion of bituminous coal dust by the firing of charges, by gas currents acting on various types of safety lamps, by the breakage of the globe of an incandescent

lamp in an explosible gas atmosphere. In respect to the latter point the effect of the comparative thickness of the filament was very striking. When the globe of a lamp with a comparatively thick carbon filament is broken, usually an explosion results; when the globe of a lamp with a frail tungsten filament breaks, an explosion is very unlikely. Tests of fire brick and tests of a piece of cable on a 600,000-lb. testing machine were also shown.

On Thursday afternoon, the following optional excursions had been arranged, and in each of the four parties a large number participated. The first party visited the Isabell furnaces of the Carnegie Steel Company, Etna (the historical first Gayley dry-blast plant) and the Park works of the Crucible Steel Company of America, the largest crucible steel furnace plant in the world. The second party visited the works of the Jones & Laughlin Steel Company, which are the largest independent works outside of the United States Steel Corporation, and specially interesting for the Talbot open-hearth department. The third party visited the lead-silver plant of the Pennsylvania Smelting Company, of Carnegie, Pa., and the fourth party the works of the Universal Portland Cement Company, where cement is made from limestone and granulated blast-furnace slag. The plants of the Nernst Lamp Company and of the Pittsburgh Reinforced Brazing Company were also visited in the same afternoon.

For Friday, a most interesting and successful all-day excursion by means of a special train had been arranged. The first visit was to the Allegheny Plate Glass Company's plant at Glassmere. This was followed by a visit to the works of the Westinghouse Electric & Manufacturing Company and of the Westinghouse Machine Company. Lunch was taken on the train, which brought the party to the works of the Firth-Sterling Steel Company at McKeesport, where a 2.5-ton electric steel furnace of the Héroult type was shown in operation. Finally the magnificent Homestead works of the Carnegie Steel Company were visited. In the evening of Friday an informal subscription dinner was held at the Fort Pitt Hotel, where Mr. Scott acted as toastmaster.

On Saturday, in connection with the meetings at the University of Pittsburgh and in the Carnegie Music Hall, the equipments of the University of Pittsburgh, of the Carnegie Technical Schools and of the Carnegie Institute were inspected.

Four business sessions were held, the first two on Thursday morning and evening in the convention hall of the Fort Pitt Hotel, the third on Saturday morning at the University of Pittsburgh and the fourth meeting—which was open to the general public—on Saturday afternoon at the Carnegie Music Hall.

The meeting of Thursday morning was called to order by President Dr. Leo H. Baekeland, whereupon addresses of welcome were made by Mr. B. F. Morse, president of the Engineers' Society of Western Pennsylvania, and Mr. Charles F. Scott, chairman of the general local committee.

The report of the board of directors showed the society to be in a flourishing condition. There were elected in 1909 290 new members, the total number of members on Dec. 31, 1909, being 1066—it is now above 1200.

The results of the election of officers were then announced. Dr. William H. Walker, of the Massachusetts Institute of Technology of Boston, is the new president of the society. Mr. P. G. Salom and Dr. J. W. Richards were re-elected treasurer and secretary, respectively. Dr. E. F. Roeber, Mr. S. S. Sadtler and Dr. Louis Kahlenberg were elected vice-presidents for two years; Prof. C. F. Burgess, Mr. C. P. Townsend and Dr. W. R. Whitney managers for three years.

ELECTRODE LOSSES.

Two papers on furnace electrode losses were presented by Mr. Carl Hering. The first paper dealt with the determination of the constants of materials for furnace electrodes and described in detail the apparatus and method used in the experimental investigation, the results of which were given in a paper read at the Charlotte meeting of the American Institute of Electrical Engineers.

Briefly described, the method consists in embedding a rod of the material to be tested in a heat-insulating material, allowing the two ends to project sufficiently for terminals. The rod is then heated by a steady current until it becomes sufficiently hot midway between the ends. The temperatures at the middle and at the ends, the voltage at the two ends, and the current, are then measured. From these data all the necessary physical constants are then calculated. The product of the volts and amperes gives the rate of transfer of heat, in watts, which flows out at the two ends, and from this value and the dimensions the heat conductivity is calculated. The rod is equivalent to two electrodes butting together at their hot ends, the interior of the furnace itself being omitted; hence the entire flow of heat is that due to the loss in the resistance of the electrodes, which is the condition under which a well-proportioned electrode should operate.

The rod is assumed to be perfectly heat insulated; this condition is nearly obtained by surrounding it with a cage of similar rods through each of which the same current passes. A stable state of temperature is, of course, essential.

The object of the second paper of Mr. Hering, entitled "Empirical Laws of Furnace Electrodes," was to find simple empirical laws for his two fundamental quantities, E and S', which together are all that is required for calculating an electrode. When measured in volts E represents the specific loss in watts per ampere for any particular range of temperature. The quantity S' is the specific section for any particular range of temperature; that is, it is the cross-section required per ampere and per inch of length. Both E and S' are the particular values under the assumed condition that there shall be no flow of heat either way through the hot electrode end. The curves giving E as a function of the temperature drop T between the two electrode ends are found to be hyperbolas, while the curves giving S' as a function of T follow a law of the form $S' = m + n/T$.

In a written communication Dr. A. E. Kennelly gave some theoretical deductions from Mr. Hering's experimental results in connection with the Wiedemann-Franz law. Mr. H. W. Gillette gave some experimental results of measurements of the temperature gradients in carbon and graphite electrodes of a carborundum furnace, showing a general similarity of the temperature curves for graphite and carbon. Mr. Hering replied that in the experiments neither the condition was fulfilled that there shall be no heat flow either way through the hot electrode end, nor was the stable condition of temperature reached. Messrs. Lidbury, Richards and Queneau also participated in the discussion.

CONDUCTORS FOR HEAVY CURRENTS.

Mr. K. C. Randall read a paper, entitled "A Study in Heavy Alternating-Current Conductors for Electric Furnaces." The chief points brought out by the paper are as follows:

The size and shape of the conductors and the operating frequency determine the magnitude of the "skin effect." The form and dimensions of the circuit and the frequency determine the self-induction. "Skin effect" and self-induction are reduced by laminating the individual conductors, by the selection of conductors of the proper size and shape, and by interlacing the conductors. The reduction of the self-induction in the circuit is the most important and most difficult. The paper was discussed by Mr. Hansen and Mr. Lloyd.

DUCTILE TUNGSTEN AND MOLYBDENUM.

A very interesting paper on ductile tungsten and molybdenum was presented by Dr. C. G. Fink. A full abstract of it is given elsewhere in this issue. In the brief discussion which followed, the description of the process of making ductile tungsten was promised for a later occasion, and the process was stated to have resulted in a "new tungsten lamp."

ELECTRIC STEEL FURNACE.

A preliminary account of the construction of a new electric steel furnace was given by Mr. A. L. Queneau. The object is to make use of the pinch effect for the circulation of the charge. In its simplest construction the furnace has one upper carbon electrode suspended from above and a lower metallic electrode in the bottom. The latter electrode is liquid at its upper end,

which is in contact with the furnace charge, and by a slight restriction of the cross-section at this point the pinch effect is produced. The weight of the metal above causes the contact to be closed immediately afterward, so that there is produced at this point a continuous breaking and closing of the metal column which results in a thorough stirring and circulation of the charge of the furnace. A furnace of this kind is in course of construction, and an account of the results obtained is promised for a later meeting.

GASES IN STEEL.

A brief paper was presented by Dr. Paul Héroult in which the hypothesis was brought out with great force that gases in steel are harmless and that they do not produce blowholes. Blowholes are the result of disengagement of carbon monoxide, due to the interaction of carbon and iron peroxide at the time of solidification. Hydrogen, nitrogen, etc., gases are harmless; they are contained to about the same extent in Bessemer, basic or acid open-hearth or crucible or electric steel.

MAGNESIUM.

A paper was presented by Prof. Samuel A. Tucker and Mr. Farel L. Jouard on the electrolytic preparation of magnesium. Magnesium can be obtained by electrolysis of its molten chloride in the presence of potassium chloride, but the bath is troublesome and expensive to prepare. Electrolysis of magnesium fluoride with additions of other fluorides for dissolving oxide of magnesium gave practically no metal, and there seems to be no direct solution of magnesium in such molten compounds. Alloys of magnesium with aluminum or copper are easily made by electrolysis with the use of a chloride bath.

Telegraph Cable Relay.

In the accompanying diagram are shown the devices and connections now in experimental use for transmitting and receiving messages over the Western Union Telegraph Company's cable line, 800 miles in length, from Canso, Nova Scotia, to New York City. The messages are sent by means of the ordinary telegraph key and received on the ordinary telegraph sounder.

According to the usual practice, cable messages are received by a siphon recorder and are translated from a tape upon which the "dots" are formed on one side and the "dashes" on the other side of a zero line near the middle of the tape. Difficulty in using a "sounder," such as is employed with land lines, when receiving messages over a cable line arise by reason of the irregularities of the impulses reaching the distant end of the cable. The siphon recorder developed for this purpose gives excellent service, but requires special training for the interpretation of the messages, while "relaying" presents such great difficulty that cablegrams intended for delivery inland are retelegraphed over the land lines instead of being automatically transmitted to their destination without intermediate handling. In cable telegraphy, the current is always fluctuating and there are always electric ripples—so to speak—moving the tongue of the receiving device from one place to the other; the impulse which arrives at the receiving station is always fluctuating in itself, and the tongue, therefore, moves sometimes a greater distance and sometimes a lesser distance. Such action is called the "moving of the zero" and it is obvious that with such action an instrument with stationary contacts cannot be used.

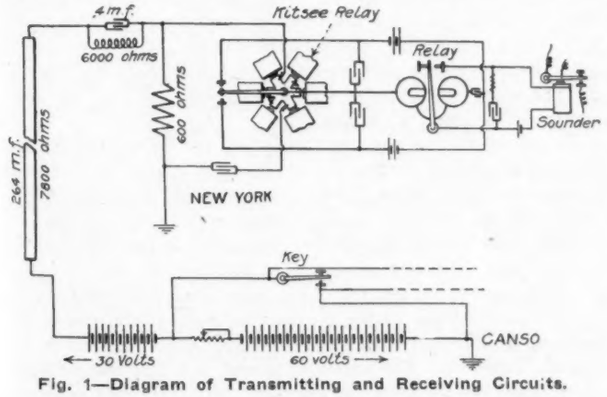


Fig. 1—Diagram of Transmitting and Receiving Circuits.

According to the system illustrated herewith the impulses as received on the cable are translated locally into impulses of greatly increased strength by means of automatic relaying devices at the receiving station. At the transmitting end use is made of two batteries, one giving 60 volts and the other 30 volts, arranged with their e.m.fs. in opposition, so that the two in series give a resultant e.m.f. of + 30 volts. The transmitting key short-circuits the 60-volt battery, leaving an e.m.f. of — 30 volts impressed on the circuit. Thus the e.m.f. varies from + 30 to — 30 volts, but at no time is the circuit open.

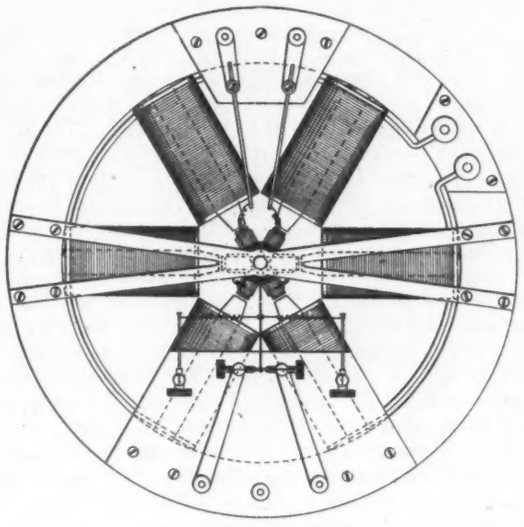


Fig. 2—Special Relay.

At the receiving station use is made of impedances for maintaining the circuit in a closed condition and condensers for storing charges for operating the receiving devices by means of the impulses transmitted over the cable. The receiving device proper is a special polarized relay connected in series with a 4-mf. condenser, which is in parallel with a 600-ohm impedance. This arrangement eliminates the "moving zero," which may be attributed to unidirectional currents, and these have no effect in the condenser circuits. According to the direction of the impulses received by the special polarized relay through the condenser, the armature of the relay moves to the right or left and thereby closes one or another of two local battery circuits joined to an ordinary polarized telegraph relay.

The line relay, which is of a peculiar type, consists of a circular yoke of iron to which are secured six radially extending cores arranged alternately with opposite poles. Upon these cores are disposed windings connected in series with each other and the terminals of these windings are connected to binding posts for the purpose of joining them with a suitable exciting circuit. Disposed between these pole pieces is a stationary core of iron supported by brass screws to the frame proper. Upon the top of the yoke is secured a bridge or bracket of brass and upon the underside is secured a similar bridge or bracket. At their centers, these brackets support jewels and in which are journelled the supports for three movable coils. These three coils are disposed at an angle with respect to each other. Their terminals are connected to binding posts resting on the frame and are adapted through these binding posts to be connected to the cable. The support of the three coils carries a tongue or arm, and in proximity to the end of this tongue are stationed two contact points.

The special transmitting arrangement and the polarized relay were devised by Dr. I. Kitsee and constructed under his direction. It is claimed that the Kitsee arrangement provides the first equipment for receiving cable messages by means of a common sounder using ordinary Morse signals and that the speed can reach 35 words per minute.

Massachusetts Legislative News.

Governor Draper has signed the bill relative to the liability of street railway companies for the safety of passengers. The act provides that no street railway company shall by rule or otherwise require passengers whom it permits to ride upon the platform to do so at their own risk, and that no such passenger shall be prevented from recovering compensation in damages for any injury by reason of the fact that he is so riding. The bill providing for the placing of wires underground in the business center of the city of Salem within the next five years has been signed by the Governor. The act does not apply to long-distance telephone or electric railway conductors. Governor Draper has signed the bill permitting 10 or more persons to form a corporation for making, selling and distributing gas for light, or for heating, cooking, chemical and mechanical purposes; or for the purpose of generating and furnishing hydrostatic or pneumatic pressure for mechanical power, in any municipality, with a capital of not less than $1,000 nor more than $500,000. The Governor has also signed the bill amending the law relative to increases of capital stock of gas and electric light companies. The amendment provides that no application for an issue of stock shall be made unless authorized by vote of the stockholders passed not more than four months prior to such application, but the vote of the stockholders to increase the capital stock may be passed before or after the action of the Board of Gas & Electric Light Commissioners. All votes and proceedings relative to the increase and all rights of the stockholders to subscribe for the new shares become void unless the directors, after the vote to increase the capital stock and within 60 days after the final action of the board, shall cause written notice to be given of such increase to be given as provided by law. The bill exempting the transit bonds of the city of Boston from the provisions of law relative to losses made by that city has been signed by the Governor.

The committees on railroads and street railways, sitting jointly, have agreed to report a bill permitting the New York, New Haven & Hartford Railroad Company to acquire a controlling interest in the Berkshire Street Railway Company, subject to the approval of the Railroad Commission as to terms of acquisition. The railroad company cannot dispose of any of the capital stock of the street railway without the approval of the Railroad Commission, and the fares are not to be increased or the facilities of travel decreased. Within two years the New Haven is to build lines between Huntington and the Hinsdale district; a line to the summit of Mt. Greylock; a line from Great Barrington through Sheffield to the Connecticut boundary, with a branch to Egremont; and such extensions, double tracking, and track reconstruction in North Adams and Pittsfield as the Mayors and City Councils shall within six months request, and the commission approve. It is proposed to expend $2,000,000 on the Berkshire trolley improvements.

The committee on street railways has reported a bill limiting the time of construction of electric railroad companies. The bill provides that if an electric railroad company incorporated under chapter 516, Acts 1906, does not begin construction and expend thereon at least 10 per cent of the amount of its original capital stock within two years after the date of its certificate of incorporation, and does not complete and open its railroad for use within four years, its corporate powers and existence shall cease, unless the Railroad Commission, after hearing, shall extend the time. A similar provision applies to extensions. An effort to amend the Dean bill to limit the charges for telephone service by providing that the Massachusetts Highway Commission should consider instituting a charge not exceeding 5 cents for a three-minute telephone toll call to and from Boston and all parts of the Boston suburban district has been lost by a vote of 28 to 40 in the House. A resolve has been introduced into the House by the committee on metropolitan affairs providing for a report by the Boston Transit Commission to the Legislature of 1911 on the cost and necessity of constructing a tunnel from Park Street through the Dorchester district, of a subway from Park Street through Dorchester Avenue to Milton Lower Mills, and of a subway from Park Street to Marine Park, South Boston. The bill relative to the sale of electricity in Clinton by the Metropolitan Water & Sewerage Board has been given a second reading. The committee on metropolitan affairs' resolve providing for an investigation of the cost of a subway from Park Street to the South Station, by the Boston Transit Commission, has been passed to be engrossed by the Senate. The bill transferring from the Railroad Commission to the district police certain powers and duties relative to the transportation of explosives has been given a first reading in the House. The bill authorizing the granting of temporary locations to street railways by the Railroad Commission has been given a first reading in the Senate. The bill defining and extending the authority of the Railroad Commission to supervise the issue of bonds by street railways has been ordered to a third reading in the House. The bill for legislation to increase the salaries of the Gas & Electric Light Commissioners has been read a second time in the House.

Wisconsin Rate Commission News.

The commission has approved the application of the Duluth Street Railway Company for authority to issue $2,500,000 par value of general mortgage, 20-year, gold coupon bonds. These bonds are of the denomination of $1,000 each and are to bear interest at the rate of 5 per cent per annum, payable semi-annually, and are to be redeemable at the option of the company on any interest day after May 1, 1915, at 105 per cent of the face value. Of the total issue, $300,000 are to be for the purpose of supplying the company with funds to reimburse the treasury for expenditures made for additions and extensions to its plant and system during the years 1908 and 1909, by establishing a reserve fund, which, under the terms of the trust deed securing the bonds, can only be used in payment of expenses for new property acquired, and additions, extensions and permanent improvements made subsequent to Jan. 1, 1910. The remainder of the issue is to be used for supplying funds with which to carry on future improvements. The bonds are to be issued for money only and for not less than 75 per cent of the par value. The assets of the company, on Dec. 31, 1910, amounted to nearly $5,500,000.

In the matter of the application of the Waupaca Electric Light & Railway Company for authority to adjust its rates, the commission acted upon its own initiative in investigating the merits of the proposed changes inasmuch as no witness appeared either for or against the application at the time set for the hearing. The new schedule, as proposed by the company, provides, on the whole, for lower rates than the present ones and eliminates some of the inequalities, such as the distinction between regular and irregular consumers, which existed in the original schedule. The commission did not find the schedule as proposed by the company entirely satisfactory and proposed an alternate system of rates, as follows: First 10 kw-hours at 12.5 cents per kw-hour; next 90 kw-hours, 9 cents; next 400 kw-hours, 6 cents; all in excess, 5 cents. Under the proposed alternate schedule the net revenues will remain practically unchanged, but the readjustment will result in a more equitable charge per consumer, by eliminating the discrimination heretofore present. The charge for the rental and the reading of

meters has been abolished and a uniform minimum charge of 75 cents per consumer substituted.

The Milwaukee Northern Road appeared before the commission on Tuesday to oppose the granting of a certificate of convenience and necessity to the Fox River Valley Company for the construction of an electric line from Cedarburg to Milwaukee. The attorneys for the former road contend that from Cedarburg the proposed line would enter into competition with the Milwaukee Northern to Milwaukee, whereas the transportation needs of this territory are already adequately filled by the above company. The commission continued further hearings on the application to May 25 and 26, in order to give the attorneys for the applicant road time to complete their briefs.

Maryland Public Utilities News.

Mr. James M. Ambler, chairman of the Maryland Public Utilities Commission, and Mr. Philip P. Laird, one of the two associate members—the other being Mr. Walter W. Abell, who is abroad—took up their official work last week. Attorney-General Straus joined with them and several days were spent in going over the law, Mr. Straus, the draftsman of the law, explaining its provisions. Up to this time no counsel has been appointed, nor has an assistant counsel. Mr. Ambler is the only legal member of the commission, and it is doubtful if he would care to take the responsibility of deciding the legal phases of a question with no counsel to guide him. Attorney-General Straus will probably supply the deficiency until the permanent counsel is selected.

One of the first complaints made before the commission was in regard to the alleged practice of the Consolidated Gas, Electric Light & Power Company in occasionally demanding a meter deposit of $5. The complainant did not object to the payment, but asked that the company be required to pay interest on the money, which, he says, was formerly done. In explaining the procedure and the power of the commission, at the time, Mr. Straus said: "Any individual or group of individuals can make a complaint to the commission, upon which action must be taken. They can state their grievance verbally or in writing. When the grievance has been set forth, it is forwarded to the corporation against which it is made, with the request for an answer within a specified time. When the answer has been produced, the commission can take such action as the case warrants. Orders may be sent to the corporation directing it to remedy the trouble, or the grievance may be ignored as unfair or beyond the power of the corporation to remedy. The commission itself may take the initiative, as nothing in the law prevents it from undertaking an investigation on its own responsibility. When complaints have been made the commission passes on them as a judicial body, its legal advisors and its clerical force being a part of its judicial machinery. Should delegations wait upon the commission asking for a hearing at which it can set forth a complaint, the counsel for the commission cannot act as a public prosecutor. After the complaint has been registered and the commission decides that the question demands action on its part, an investigation is started with a view at getting at all of the facts involved. It may then dismiss the proceedings for such reasons as appeal to it, or it may issue an order correcting the alleged grievance. In ascertaining such facts as the commission needs and in preparing its order to correct grievances the clerical force and the counsel are employed."

The Consolidated Gas, Electric Light & Power Company has announced to Superintendent of Lamps and Lighting McCuen that it will be perfectly satisfied with a one-year contract with the city for electricity and gas, and that in the meantime it is willing to submit the matter of rates to the Public Utilities Commission for its verdict. The commission is also in receipt of a communication from Mr. McCuen in which he asked if the commission would take over the testing of gas and electric meters. Mr. Straus, who is acting as the general counsel, instructed Mr. McCuen to continue to do this work until the commission arrives at a definite conclusion.

Heads of the public-service corporations are reported as saying that they are seeking or avoiding controversies with the newly formed commission, and that they are ready to appear when summoned and lay bare their books, accounts, capitalization and salary lists. Mr. C. H. Weber, of the Chesapeake & Potomac Telephone Company, expressed this view last week: "We do not see that we are called on to go to the commission until it asks us to come. When it does we are ready and our doors are wide open for any investigation it may wish to make. This will probably come when we wish to increase our capital or ask for new franchises. I do not know that either is now in contemplation. So far as individual complaints are concerned, we take care of them ourselves, keeping an intelligent force on duty. The commission could not help us in this regard, nor do we think that our methods are subject to just criticism, for every complaint is sifted to the bottom and remedied. This is done by going to the root of the difficulty and fixing the blame, if any. We appreciate the fact, in common with other public-service concerns, that as our support comes from the public, we must please and satisfy it. This is our constant aim and would be regardless of any State commission which may have jurisdiction."

New York Public Service Commission News.

Governor Hughes, last week, signed the bill, recently passed by the Legislature, amending the rapid transit act so as to allow subways to be equipped with moving platforms if deemed advisable; to allow the purchase of energy by the operator of a subway instead of necessitating the building of separate power houses, and legalizing the investment of trust funds in real estate in which there exists a rapid transit easement. The last provision of this new law will enable the city to sell property valued at something like $1,000,000 which it was necessary to acquire in the construction of the Bridge Loop subway.

The Public Service Commission for the First District will give a hearing on May 12 upon the application of the Third Avenue Bridge Company, a subsidiary of the Third Avenue Railroad Company, for a certificate of convenience and necessity to operate across the Queensboro Bridge. The Board of Estimate and Apportionment has already granted a franchise to the company. An application for a certificate from the commission was denied last year upon the ground that the route did not sufficiently convenience the public. A more liberal plan is presented in the new application.

A petition was presented to the commission last week signed by 150 Brooklyn property owners asking it to authorize the construction of a subway from Eastern Parkway down Nostrand and Flatbush avenues to Coney Island under the assessment law. The plan provides for about 2½ miles of subway and four miles of elevated road. It would cost about $9,000,000, but it is estimated that an assessment apportionment would not average more than $100 per lot, which, according to the law passed last year, would be payable in 10 yearly instalments.

Mayor Gaynor has approved the act putting in force the constitutional amendment permitting the elimination of revenue-bearing city bonds from calculation in the limit of indebtedness. It is expected that the Governor will approve the bill as soon as it is submitted to him, and the Court of Appeals will then be asked to designate the bonds that may be so eliminated. In preparation for this the Board of Estimate and Apportionment last week adopted a resolution instructing the comptroller to prepare with all possible speed statements showing the bonds that may be included in the exempt list. It is generally understood that there are $47,000,000 worth of the city bonds issued for the construction of subways which will be eliminated without any question, and it is expected that there will be found at

least $60,000,000 of dock bonds that are really self-sustaining.

The Board of Estimate has authorized Comptroller Prendergast to issue $150,000 worth of corporate stock of the city so that the Public Service Commission can pay for the extra work on the contract for the construction of the Fourth Avenue subway in Brooklyn. The matter of installing pipe galleries in the subway was laid over.

The Public Service Commission, Second District, has granted the application of the Islip Electric Company to exercise franchises granted by the villages of Islip and East Islip, Suffolk County. The company proposes to manufacture and distribute electric energy for street and commercial lighting. The application was opposed by the Suffolk Gas & Electric Company, which is now serving gas in the villages in question. This company supplies electricity to the village of Bay Shore and parts of the town of Islip, but has not furnished electric energy to Islip and East Islip. The commission in granting the application holds that in territory into which an electric light company seeks to enter not actually occupied by another company, permission to begin such construction ought not to be denied because another company located in and already serving an adjoining territory claims that it is able, ready and willing to serve the territory sought to be entered. Where the objecting company is not actually supplying the territory to be served, it cannot claim that such territory "belongs" to it. The commission points out that as a business proposition it would be more economical for the communities sought to serve to make terms with neighboring and existing companies. It does not consider that it is its function to do more than refer to such a course.

A hearing will be held this week on the complaints of residents of White Plains, Portchester, Eastchester, Irvington and of the Public Welfare Association of the villages of Tarrytown and North Tarrytown against the Westchester Lighting Company as to the price and service of gas and electricity in these villages; also on the joint petition of the Riverhead Electric Light Company and Hallett Electric Light Company for the issuance of capital stock and for authority to the Hallett company to acquire capital stock of the Riverhead company, also the works, franchise and system. At Richfield Springs the application of the Hartwick Power Company for permission to exercise the franchise granted by the village of Richfield Springs will be heard.

Massachusetts Commission News.

The Massachusetts Gas & Electric Light Commission has been petitioned by the Easthampton Gas Company for authority to issue new stock to the amount of $100,000, for the payment of floating debt and meeting the cost of enlargements of the plant.

The Hadley Lighting Company has applied to the board for the right to issue new stock to the amount of $10,000 for the purpose of buying the business of an acetylene lighting organization and going into the business of electrical supply.

The Railroad Commission has approved an increase of stock by the Berkshire Street Railway Company amounting at par value to $300,000, for the purpose of enabling the company to purchase the Pittsfield Street Railway Company. The board points out that the purchase permitted will involve no decrease in facilities for travel and no increase in rates of fare. It is expected that the Berkshire company, which is controlled by the New England Investment & Security Company of Springfield, will largely rehabilitate the service and equipment of the Pittsfield property.

The selectmen of Amesbury recently petitioned the Railroad Commission for approval of a relocation of tracks in that town by the Haverhill & Amesbury Street Railway Company. The municipal authorities specified that the company must use flat girder rails, and that the tracks must be laid in the center of the streets. The commission has issued an order approving the relocation, but with the amendments that 4.5-in. T-rails are to be used, and that the track is to be located on the side of the highway, 4.5 ft. from obstructions, measuring from the inner rail. The board has approved the sale of the Hartford & Worcester Street Railway Company to the Worcester & Southbridge Street Railway Company for the sum of $140,000. The board has ordered the sale by auction of 596 shares of the Milford & Uxbridge Street Railway Company which remain unsubscribed by stockholders.

At the request of the legislative committee on street railways the Railroad Commission has redrafted the bill providing for the purchase of stock of other street railways by the Boston Elevated Railway Company.

The joint Commission on Metropolitan Improvements has sent a letter to the legislative committee on metropolitan affairs recommending that no law be passed this year providing for the construction of a tunnel between the North and South Stations at Boston. The commission suggests that a resolve be passed requiring it to report to the next Legislature the draft of a bill for such a tunnel. If this tunnel is built it will unquestionably be operated by electricity, and such a step brings to the front the question of the electrification of the steam railroads entering the city. It is probable that the joint commission will consider electrification at some length during the coming summer and autumn, and will embody its conclusions in any discussion of an interstation tunnel which may be presented to the Legislature of 1911.

The Massachusetts Railroad Commission recently gave a public hearing on the petition of citizens of Raynham for a fare reduction on the Taunton-Brockton line of the Old Colony Street Railway Company. Mr. Bentley W. Warren, Boston, represented the company. The issue was whether a small number of persons living between the Taunton-Raynham boundary and Raynham Center should have the benefit of the 5-cent local fare from the Raynham boundary to Bridgewater, in which instance the fare from the south side of Raynham to Bridgewater would be 10 cents instead of 15, the latter being the fare charged all through passengers. Mr. Warren stated that several years ago at the request of the inhabitants of the town, 5-cent fare was granted to Taunton, necessitating a change in the limits of the fare zones. To accommodate local passengers within the limits of Raynham identification checks are issued which provide a 5-cent fare between points in the town. The company maintained that the establishment of the 5-cent fare to Taunton, including transfer privileges at the latter city, was for the public benefit, and that the few persons who might occasionally be incommoded in going the other way was too small a number to warrant a return to the old arrangement. The case in issue is a small one, but the principle involved is of general interest. A company cannot charge fare limits on behalf of the greatest good to the greatest number without laying itself open to the criticisms of the minority, and it is out of the question to expect a railway to give a local service which conflicts with the reasonable charges for a through traffic over the same lines. The board took the case under advisement and issued an order sustaining the company. The petition was dismissed without prejudice.

A hearing was given by the same commission on May 3 upon the Watertown-Boston service of the Boston Elevated Railway Company. The petitioners objected to the withdrawal of Park Street subway cars from the Watertown-Cambridge lines. Vice-President C. S. Sergeant, for the company, said that the cars were withdrawn to relieve the congestion on Boylston Street, Boston, and that the transfer required at Harvard Square is nothing more than many thousands of persons make elsewhere on the system daily without any objection whatever.

The completion of the Cambridge subway will provide fast service to Boston by means of a transfer between cars and trains at the Harvard Square station. It is unavoidable that some irregularities of schedule shall exist in a city where a subway is under construction. The conditions which are at present troublesome are in large measure temporary in character. The hearing was closed.

CURRENT NEWS AND NOTES.

Money for New York Subways.—A bill making available immediately about $47,000,000 for the additional subways in New York City has been passed by the Legislature of the State.

English Electrical Imports and Exports.—The returns for the first three months of this year show that the English imports of electrical goods increased by $100,250 and the exports by $3,437,500 over the corresponding figures for last year, the totals for this year being $1,742,000 and $5,555,000.

New York Watersheds.—The New York Assembly has passed the Fowler bill providing for an exhaustive examination into the watersheds of the State, with reference to development of power, storage, drainage, irrigation, prevention of floods, development of canals and improvement of rivers.

Telephone Cable Across the English Channel.—The first gutta-percha insulated telephone cable equipped with Pupin induction coils for improving the transmission of speech across the English Channel was opened for service during the past week.

Motor-driven Textile Mill in Brazil.—A large woolen mill in Rio de Janerio, the Fabrica Rink, which is now operating 1200 spindles and 104 looms, will shortly extend its plant by 700 spindles and 28 looms. The whole factory will be worked by electric motors.

Street Railway Travel in Bohemia.—The traffic on the electric street railways of Bohemia, Austria, in 1909 was as follows: Passengers, 55,679,248; receipts, $1,565,078, of which the Prague lines alone contributed 42,634,681 passengers and $1,181,312 receipts, leaving for all other street railway traffic in Bohemia 13,044,567 passengers, and $383,766 receipts.

Gasoline-Electric Cars in Massachusetts.—The Boston, Revere Beach & Lynn Railroad Company is planning to make service tests of gasoline-electric and gasoline cars between Boston and Lynn, for the purpose of determining their suitability for operation under steam railroad conditions where the expense of the usual electrical equipment would be prohibitive.

Canadian Hydroelectric System.—The provincial treasurer of Ontario, Can., Hon. A. J. Matheson, has announced that the loan of $3,500,000 for the construction of the transmission line of the Hydroelectric Power Commission of Ontario, has been successfully floated, the bonds being eagerly sought by investors.

Prevention of Accidents.—The National Association of Manufacturers requests the attendance of manufacturers and other employers, regardless of membership in the association, at the discussion on prevention of accidents and industrial liability insurance, to be held Tuesday afternoon, May 17, at the Waldorf-Astoria.

Transatlantic Wireless Telegraphy.—Public wireless telegraph service has been resumed between Glace Bay, Nova Scotia, and Clifden, Ireland. The service was interrupted last summer by a fire which destroyed the station at Glace Bay. It is stated that many improvements have been introduced in the new station while the apparatus at Clifden has been completely overhauled.

Pensions for Employes.—Following its recent announcement of a system of pension and disability payments to men injured in its employ, the United States Steel Corporation has set aside for this purpose the sum of $8,000,000, which will be consolidated with the $4,000,000 given some years ago by Mr. Andrew Carnegie for the same object. This action is regarded as an attempt to obtain a force of loyal workmen who will be content to remain with the concern as long as they live.

Long Ride by Trolley.—What is said to be the longest tour ever made by trolley is being undertaken during the present week by 21 residents of Utica, N. Y. The furthest objective point is Louisville, and stops will be made at 40 cities and villages. The party will travel in a special car equipped for the purpose. The object is to investigate park systems, waterworks, manufacturing plants and municipal government during the two weeks' trip. The total distance to be covered by the round trip will be 2050 miles.

Wireless Regulation.—The United States Commerce Committee has reported the Depew bill regulating wireless telegraphy, which reserves to the Government certain wave-lengths in which transmission of important government or distress messages may be protected in transmission. In reporting the bill it was so amended that no fee will be required, but licenses must be obtained by wireless operators from the Federal Government. The Secretary of Commerce and Labor is authorized to make the necessary regulation to govern the use of wireless instruments.

Price of Tungsten.—In a note printed last week in these columns it was stated that the present price of tungsten ore is based upon 37½ cents per pound of tungsten metal content, for ore carrying 60 per cent of tungsten. Tungstic acid, instead of the metal, should, however, have been named as the basis of valuation. The acid contains 72 per cent of metal, so that the figure quoted for the metal content should have been 52 cents per pound. The schedule now in effect in the tungsten mining field covers ore assaying from 30 per cent tungsten acid, the figures ranging from 25.5 per pound for the lower content to 37.5 per pound for 60 per cent content or over.

Mexican Waterfall Utilization.—The Mexican Department of Public Instruction has made a formal appeal to the Department of the Interior asking that no more concessions be granted for utilizing the power of waterfalls unless it is stipulated in such concessions that the proposed works shall not destroy the picturesqueness of the scene. The Department of Public Instruction urges that a law be enacted by Congress making it a punishable offense to alter watercourses so as to destroy or diminish the natural beauty of waterfalls. The Department of the Interior has taken the request of the Department of Public Instruction under consideration.

Telephonic Communication Between England and the Continent.—It is now possible to telephone from Liverpool to Paris, Brussels and several provincial towns in France and Belgium. The fee for three minutes' use of the telephone with France or Belgium is $1.95, except to Bordeaux, St. Etienne, Marseilles, and Lyons, for which it is $2.43. For regular service, reduced rates may be obtained at night if one call is made nightly for at least one month for conversations over the Anglo-French and Anglo-Belgian circuits for double periods of six minutes. It is stated by the Liverpool Chamber of Commerce that steps are being taken to establish telephonic communication between that city and Germany.

Wood-Testing Laboratory.—A wood-testing laboratory, which will be operated conjointly by the United States Department of Agriculture and the University of Wisconsin, has been erected at Madison. The staff of the laboratory will make tests on the strength and other properties of wood, to investigate the processes of treating timber to prevent destruction by decay and other causes, to study the saving of wood refuse by distillation processes, to examine the fiber of various woods for paper and other purposes, and to determine the influence of the microscopic structure of wood on its characteristics and properties. Facilities will be at hand for almost any kind of test on wood that practical conditions may require.

St. Louis N. E. L. A. Special Train.—Mr. C. H. Hodskinson of the Boston Edison Company, has succeeded the late Mr. George F. Porter as master of transportation of the National Electric Light Association. Communications on the subject of reservations in the St. Louis special train from the East should be addressed to Mr. Hodskinson at 70 State Street, Boston.

Meeting of the I. E. S.—The New York section of the Illuminating Engineering Society will hold its next meeting on Thursday evening, May 12, at the Engineering Societies Building. A paper entitled "Illumination Tests" will be presented by Messrs. Clayton H. Sharp and Preston S. Millar, and informal discussions will be given on "Standards of Light," by Mr. Charles O. Bond, and on "A High-Efficiency Reflector for Street Lighting," by Dr. Sharp.

"Buffalo Bill's" Proposed Monument.—It is said that if the wishes of Col. William F. Cody, better known as "Buffalo Bill," are carried out, a marble bison some 40 ft. high, on the summit of Cedar Mountains, Big Horn County, Wyoming, will mark his last resting place. The monumental figure is to be provided with electric lamps instead of eyes, and these are expected to shine so brightly that they can be seen in Cody, eight miles away. What will be the source of energy supply is not stated.

Iceland Water Power.—One of the undeveloped resources of Iceland is its water-power, some of the waterfalls being quite noteworthy in this connection. The Skjalfandl River falls comprise the Goda Falls with 39,200 hp, the Aldeyjar Falls with 35,800 hp, the Barma Falls with 17,000 hp. The Laxau River falls would produce 30,000 hp, the Sog Falls 50,000 hp to 70,000 hp, and the Guldfoss Falls 100,000 hp. According to the *London Engineering*, a company is now being formed to exploit these resources.

An Expert Relay.—Mr. Charles A. Brown, in his recent address before the Chicago Electric Club on "Episodes in Electrical Invention and Patent Litigation" related the following anecdote of Mr. Stephen W. Field: Mr. Field had invented in connection with a quadruplex telegraph a neutral relay—that is, a relay with an armature or tongue acting in one direction or another according to the magnetic strength of opposing poles. In his patent application Mr. Field gave the title "Expert Relay" to the invention, and the examiner in his first action asked for an explanation of the peculiar name. In reply Mr. Field said: "I call my relay an expert relay because it has a tongue which is adapted to lie on either side with equal facility according to the influences brought to bear on it."

Gray and the Invention of the Telephone.—In a recent address before the Chicago Electric Club, Mr. Charles A. Brown stated that lack of good advice contributed in depriving the late Elisha Gray of participation in the honors and rewards for the invention of the telephone. He and Bell filed on the same day (Feb. 14, 1876) what are stated to be identical descriptions of the telephone. Gen. Anson Stager, who was then superintendent of the Western Union Telegraph Company and directly in authority over Gray, informed the latter that he must drop the telephone, which he considered a toy and incapable of practical use, and confine his attention to the multiple telegraph. Acting on this advice, or order, Gray did not develop the telephonic principle he discovered.

Merit System for Commonwealth Edison Company.—It is announced that the Commonwealth Edison Company has established a merit system for the purpose of recognizing more effectively faithful and competent service on the part of employees. The plan consists essentially of a system of merit and demerit markings under general headings of punctuality, attendance and performance of duty, the last named being further analyzed under seven subdivisions. It is expected, according to the *Edison Round Table*, that this system will operate as an incentive to better work, and that it will be of considerable value to heads of departments, as well as to the advisory committee in dealing with questions in which the records of employees form an important consideration.

Drainage Canal Power for Chicago Street Lighting.—Electrical energy from the Drainage Canal hydroelectric plant at Lockport, Ill., is now used extensively for Chicago street lighting by arc lamps. It is proposed, however, to extend this service greatly, and the Sanitary District wishes to purchase the city's distribution lines and street-lighting circuits, suggesting that the proceeds be used by the city to build other lines and so extend the electric street-lighting service very materially. This proposition is under consideration by the finance committee of the City Council, and it is understood that a counter proposition will be made to the Sanitary District, providing for the issuing of bonds by that body to an amount sufficient to install 10,000 additional arc lamps for street lighting.

Electric Club of Chicago.—At the meeting of the Electric Club of Chicago on May 4, Mr. F. S. Hickok, the secretary, and Mr. F. J. Postel, the treasurer, were instructed to prepare annual membership cards to be issued to members in good standing. The Chicago club has entered into a reciprocal arrangement for the exchange of club privileges with the League of Electrical Interests of St. Louis, the Omaha Electric Club, the Electrical League of Cleveland, the Colorado Electric Club and the Electrical Booster Club of Pittsburgh. The new membership cards will be useful to members of the club while in these cities or other cities having a similar electrical organization which may later enter into the reciprocal arrangement. At the meeting the treasurer reported that the club has now over $2,900 on hand.

Ohio Mechanical, Electrical and Steam Engineers.—The next annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held at the Sinton Hotel, Cincinnati, Ohio, May 19 and 20. Among the papers to be presented at the meeting are the following: "Selecting a Boiler," by Mr. F. C. Bitgood; "The Scientific Treatment of Boiler-Feed Water," by Mr. Herbert E. Stone; "Refrigerating Machinery," by Mr. H. D. Pownall; "Metallurgical Considerations in the Manufacture of High-Pressure Valves," by Mr. George K. Elliott; "The Kinney Pressure Rotary Pump," by Mr. C. O. Thurston; "Centrifugal Pumps, Their Uses and Limitations," by Mr. L. G. Finlay. Inspection trips will be made to the plants of the Union Gas & Electric Company, Lunkenheimer Company, Triumph Electric Company, Cincinnati Traction Company's turbine plant, and the new water works at California, Ohio. Mr. Frank E. Sanborn, Columbus, Ohio, is secretary of the association.

Co-operation of Telephone Operators.—In a number of the large cities there are now as many telephone operators, or more, employed in private branch exchanges on the premises of subscribers as in the telephone exchanges themselves. These private-branch-exchange operators are just as vital to telephone service as the regular exchange operators. In order to promote mutual understanding and co-operation between these forces, the Chicago Telephone Company some time ago instituted the practice of having the chief operators in its exchanges invite private-branch-exchange telephone operators to take lunch with them and the supervising forces in the exchange buildings. So far 500 or more of these operators have accepted the invitation and have had the opportunity to visit the exchanges and become acquainted with a number of operators, supervisors and others. They have been particularly shown how important their co-operation is in making and receiving calls and have no doubt benefited themselves as well as the telephone service of their employers and those who may make use of it.

THE BOSTON OPERA HOUSE.

Elaborate Electrical Equipment Provided for the Needs and Embellishments of Musical Drama.

AMONG the institutions which have recently been established in the outer Back Bay district of Boston for the purpose of enriching the artistic and educational life of the community, the Boston Opera House occupies a place of unique importance. Like many other large cities in America, Boston has for many years been entirely dependent upon outside operatic organizations for the supply of that combination of music and drama which attains the highest triumphs of the modern stage. In the realm of pure music Boston has for more than a quarter of a century maintained a symphony orchestra of the first rank, but until the fall of 1909 the city possessed no home of opera, and was obliged not only to content itself with such performances as visiting companies could furnish in fortnight engagements occurring but a few times in a season, and often only once or twice a year, but in playhouses unsuited to the latest requirements of the musical drama. Through the munificence of Eben D. Jordan, Esq., aided by a large number of public-spirited persons of influence in the community, the Boston Opera House is now closing its first season, and its attraction of patronage from all over New England marks a distinct forward step in the popular appreciation of a branch of art which guarantees a permanent enrichment of life.

The appointments of the new building exceed those of most playhouses now in service on this side of the Atlantic. Located on Huntington Avenue, between Symphony Hall and the new Museum of Fine Arts, the structure enjoys a position of commanding influence. With a somewhat severe exterior of brick after the fashion of Symphony Hall, the artistic beauty of the interior is all the more striking. Designed with a framing of steel and concrete, the requirements of strength and protection from fire have been met in full degree. The arrangements of the building have been subordinated in detail to the fundamental requirements of operatic presentation, including ample quarters for the administrative staff, spacious rooms for the artistic personnel, liberally apportioned rooms for subordinate performers and employes engaged in the vast amount of auxiliary work which is done out of sight of the public in the conduct of a great playhouse, and admirably proportioned auditorium, corridor and stage facilities. Provision for comfortable promenading beyond the facilities existing in any other Boston theater were made by the architects, Messrs. Wheelwright & Haven, of Boston. Special care was taken also to insure maximum comfort and convenience in the purchase of tickets and in the arrival and departure of patrons from the building. In its mechanical and electrical equipment the establishment rises to heights of engineering development excelled by few playhouses of the present day, this work being designed and installed under the direction of the consulting engineers, Messrs. Hollis French and Allen Hubbard, of Boston.

The stage is naturally the chief point of interest in the design of a theater, and upon that of the Boston Opera House was expended unusual thought and labor. Upon this portion of the establishment novel applications of electricity for motors and for lamps have been made, and in other parts of the theater the electrical service has been carried to a refinement which makes the plant, as a whole, thoroughly responsive to the demands of performers and patrons. A large number of special electrical problems had to be solved by the designing engineers. The requirements of the lighting were most exacting, not only on account of the variations in color and magnitude of illumination needed, but also to provide for continuous lighting under all conditions where failure of service might produce serious results.

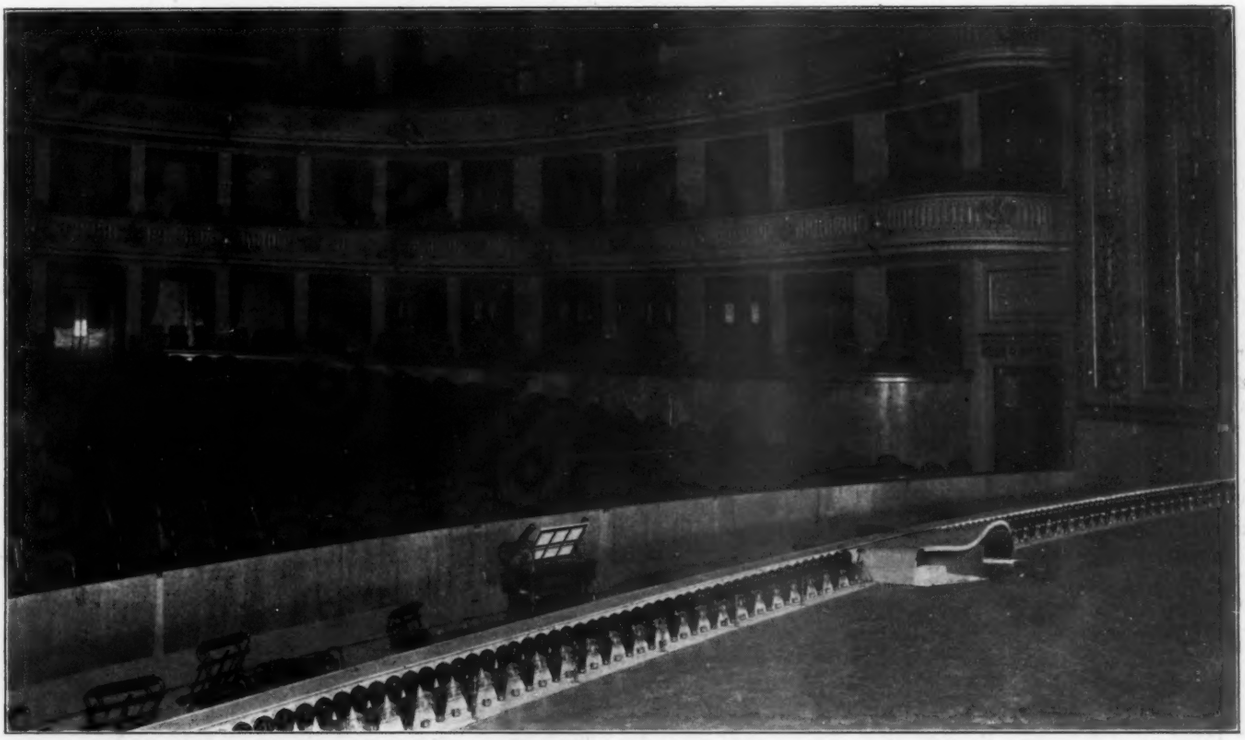


Fig. 1—View of Stage and Auditorium.

Unlike the New Theater, in New York, recently described in these columns, the stage is not of the revolving sectional type, but flexibility was obtained in the Boston installation by dividing the stage into rectangular sections, each section being raised and lowered by electric motors according to the demands of the performance. This subdivision of the stage facilitates the setting of scenes with a minimum interruption of the performance. The orchestra pit is also provided with sections

which can be raised and lowered by electric motors, six of these being installed for this service. The normal seating capacity of the house is about 2700 persons. The height from the floor of the stage to the rigging loft is 92 ft. Below the center of the stage, at the front and near the footlights, is located an operating room, 8 ft. 6 in. deep, and beneath the latter a dimmer room, 10 ft. deep. The pit below

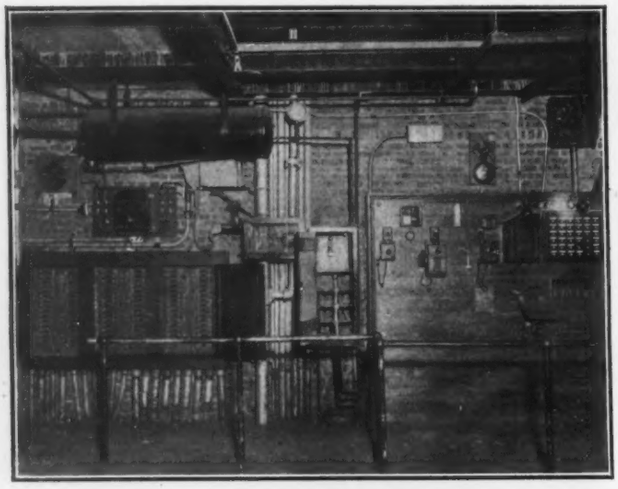


Fig. 2—Stage Manager's Headquarters.

the main portion of the stage is about 30 ft. deep. The operating room contains the stage switchboard, controlling all the lighting of the auditorium and stage with the exception of the exit lamps. All corridors, stairway exit and toilet-room lamps are controlled from a switchboard in the ticket office at the front of the house.

The electric energy is generated in a plant within the Opera House with an emergency connection of 50-kw capacity to the underground lines of the Edison Electric Illuminating Company of Boston. A total equipment of approximately 6900 lamps of various sizes is fed and the electric motor installation has a total normal rating of about 150 hp. The power plant contains a boiler installation of 500 hp, consisting of two 250-hp Worthington water-tube outfits operated at a pressure of 120 lb., and three 125-kw Westinghouse 125-volt, direct-current generators operated on the three-wire convertible system. The generators are each direct-driven by a 14-in. x 22-in. Erie-Ball engine making 200 r.p.m. Coal is handled in the plant by means of a Robbins belt conveyor which carries the fuel from a pocket into which wagons deliver by gravity to the coal storage space at the side of the boiler-room. The products of combustion are delivered from the boiler passes into a 50-in. x 40-in. smoke flue leading into a steel stack 54 in. in diameter and about 120 ft. high.

The piping arrangements of the plant are of the usual designs found where provision is made for the heating of the building by both live and exhaust steam. From each boiler an 8-in. line leads into a 10-in. main which is carried through the boiler into the engine-room, provision being made to cut either boiler in or out of service. A branch main 5 in. in diameter leads to the feed pumps and a live-steam connection is carried to the heating main of the building. The engines each take steam through a 6-in. lead and exhaust in each case by an 8-in. line carried into a 12-in. trunk line leading through the feed-water heater into the main supplying the heating coils of the building. A branch leads to an out-door exhaust at the roof in the usual manner.

The engine-room switchboard is a five-panel blue Vermont marble installation. Three generator panels are provided and two feeder panels. From this switchboard are controlled all lamps in corridors, stairways and ticket offices at the front of the house, all auditorium lighting, dressing-room lamps on the stage side of the house, private office, wardrobe and workroom illumination. Four circuit-breakers of the Condit type are installed for service on stage lighting feeders. The entire motor circuits of the building are also controlled by switches on the engine-room board. Link fuses are used on generators and enclosed fuses on feeder circuits, the former being mounted on the back of the panels. The switches are all of the single-throw type, there being but one set of busbars on the board, carried horizontally on appropriate insulating brackets. In general, the lighting feeder switches are of from 200 amp to 400 amp capacity, and the motor switches are of 400 amp rating. The generators are connected with the switchboard by 800,000-circ. mil cables.

From the mains of the Boston Edison Company service feeders are carried to a meter and distributing panel located in the basement beneath the auditorium, and thence three 400,000-circ. mil cables are carried to the ticket-office panel board, to be described later. Rigid iron conduit was used throughout in wiring the theater, with the exception of certain dressing-rooms. From the Edison service board two 300,000-circ. mil cables are carried through the basement to the engine-room, where a 25-kw motor-generator set is installed for use in supplying the building with energy through the main switchboard at such times as the plant is shut down. A 220-volt motor drives a 125-volt direct-current generator for this service, which will be utilized mainly during the summer.

About 15 feeders leave the switch studs at the engine-room board for service in various parts of the building. All portions of the distribution system which it is not desired to control from the stage switchboard or ticket-office panels are fed directly from the main board in the engine-room by sets of cables run in iron conduit exposed on the ceiling of the base-

Fig. 3—Conductor's Desk.

ment to appropriate riser shafts, and then looped through various distribution boxes. The engine-room switchboard is about 10 ft. long and 7 ft. high. Condulet fittings were used on all exposed work, and throughout the house mainly rubber-covered cables were employed. All the stage feeders are run from the engine-room horizontally across the basement ceiling to the stage switchboard, there being five sets of four 500,000-

circ. mil feeders for this service. The ticket-office board and the engine-room board are connected by eight 400,000-circ. mil cables. According to the city ordinance, the operator of the stage switchboard cannot have full control over the lamps in the corridors, auditorium and other public sections of the building. All corridor, stairway and toilet-room lamps in front of the proscenium arch are controlled from the ticket-office board, which is sectionalized in such a manner that the larger part of the lamps in the front of the house may be fed either from the Edison circuits or the Opera House generators by a single switch, and by the insertion of temporary enclosed fuses the Edison circuits may be carried back to the main switchboard in the engine-room and thence distributed to any part of the building. In some of the larger corridors of the house the lighting is subdivided to enable a portion of the service to be operated on the Edison lines, and a small amount of double circuiting has been done for the purpose of saving energy during cleaning periods and at other times when normal illumination is not required.

From the ticket-office board a large number of lamp feeders are separately fused and switched before branching to their local distributing centers. The law requires that an arc lamp or its equivalent in candle-power shall be located in the front of the house in the auditorium and controlled independently of the stage switchboard. The engineers have more than met this requirement by arranging for the control of a portion of the lamps in the central chandelier of the auditorium and certain balcony lamps from the ticket office as well as from the stage board. These lamps are thrown into operation by solenoid switches operated by a remote-control circuit, the switches being located under the second balcony and in the basement,

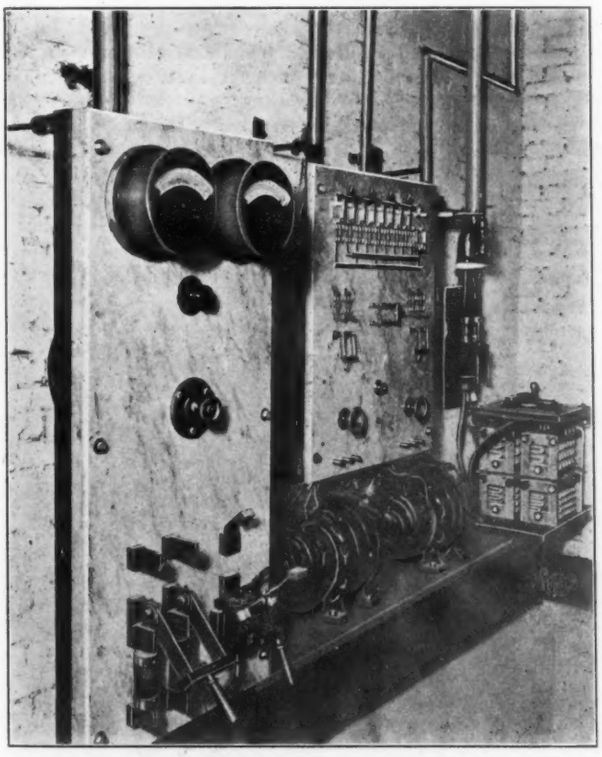


Fig. 4—Switchboard for Motor-Generator Set and Signal Dynamotor.

with appropriate risers leading from these points to the lamp groups concerned. The balcony lamps controlled from the ticket office are separately wired from the chandelier control and supply service. In general, the circuits having the greatest number of lamps are controlled by the stage operator.

The operation of the bridges underneath the stage is accomplished entirely by electricity. The front bridges, three in number, are designed to carry 1500 lb. each, and are driven by a single motor mounted in the basement at the end of a shaft which is connected by pneumatic clutches with winding drums from which steel cables are run over suitable sheaves to the bridge structure. The bridge-moving installation was furnished by the George T. McLauthlin Company, of Boston. Steel columns and girders are installed to carry the fixed portions of the

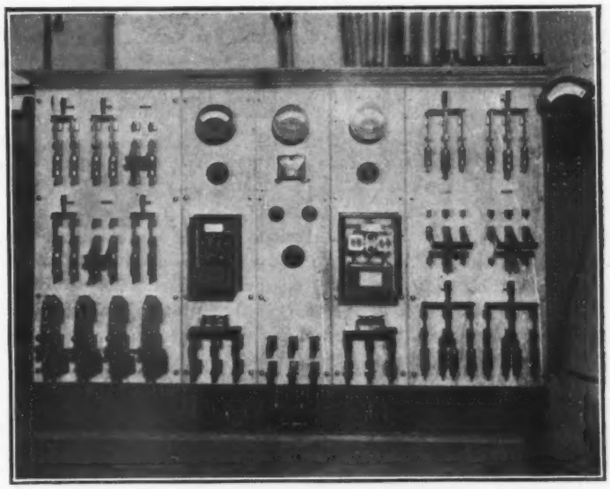


Fig. 5—Engine Room Switchboard.

stage and the framing of the movable parts is of steel. The pneumatic clutches controlling the operation of the three front bridges are piped to hand valves located in a cabinet in the right wing of the stage, where the stage manager's headquarters are located. The bridges may be operated separately or in group.

The operation of the hand valve by the stage manager or his assistant throws the main motor shaft in the basement into geared contact with the winding drum of the bridge which is to be raised or lowered, and the bridge may be held in any intermediate position desired. The front bridges are each 40 ft. long and 4½ ft. wide. The 12 back bridges are arranged in three rows of four bridges each, each being controlled from a panel mounted at the left of the stage, opposite the stage manager's headquarters. The controllers are equipped so that the back bridges can be set to rise to any stated height within the range of travel, avoiding any false movements at critical periods in the performance. Electrical control supplies a flexibility available by no other means.

The principal motors used in the building are as follows:

Application.	Motor rating, hp.
Coal conveyor	2
Plenum fan, auditorium ventilation	25
Exhaust fan, auditorium discharge	12
Ventilating fan, smoking room	1
Vacuum cleaner	10
Carpenter shop	10
Property shop	3
Elevators, passenger and freight	15
Front bridges under stage	15
Back bridges under stage, 12 motors	3.5
Removable floor of orchestra, 6 motors	3.5
Organ blower	5
Air compressor	2

A four-color lighting scheme is used in the borders, foots and pockets, the colors being red, white, blue and amber. The borders and foots are arranged in two sections across the stage, four colors to each, with separate dimming and controlling mechanism. The red and blue lamps are arranged in one row and the white and amber lamps in a second. On account of the size of the stage, the limited space available in the wings and the exigencies of operatic performances, which

frequently require the most elaborate lighting effects, it was decided to place the switchboard operator in the center front of the stage, beside the prompter. The operator of the stage board is concealed under a hood, shown in the accompanying photograph of the stage and auditorium, with his eyes just above the level of the stage floor. This enables him to watch the performance from approximately the point of view of the audience and permits more accurate adjustments of light and shade than in working from the wings.

The stage switchboard is located in a brick and concrete chamber occupying a long and narrow strip along the front of the stage pit, the length of the chamber being about 24 ft. and the depth about 9 ft. The compartment is slightly under 7 ft. wide, and the switchboard is located at a lower level than the operator underneath the hood, although in close touch with the latter. The switchboard is located one story below the stage, and below this is a dimmer room about 9 ft. deep. On the level of the operating floor in the switchboard compartment and facing the auditorium are five panels of slate upon which are mounted the operating handles for all switches and dimmers, with shafts, master handles and rigging for operating the dimmers in different combinations, as may be required. The switch and dimmer handles with master shafts and rigging for controlling the pockets for arc and bunch lamps on the left of the stage, as seen from the auditorium and the left-hand half of all border and footlights, are grouped on two panels at the left of the center, and the corresponding apparatus controlling lamps on the hight-hand half of the stage

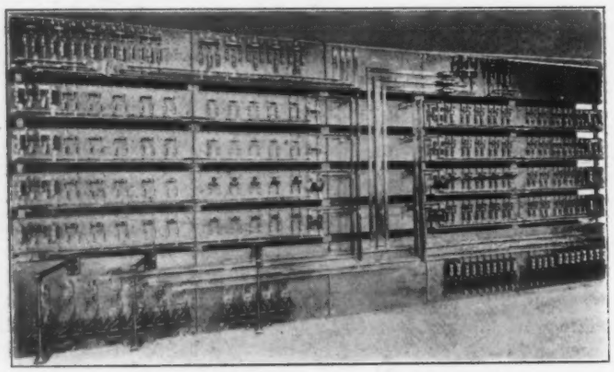


Fig. 6—Rear of Stage Switchboard.

and the right half of the border and footlights is located on two panels at the right-hand end of the board. On the center panel are installed master handles with suitable clutch connections by means of which the dimmer and switch handles on each side may be turned in groups as desired. Back of this board is located a group of slate panels carrying all the switches and busbars which are mounted on the side of the panels toward the rear of the stage. Between the two boards are iron boxes containing wires, and the rods and levers required to transmit the motion of the operating handles to the switches and dimmers. All dimmers are mounted on a steel frame and each half of the structure is served by a 0.5-hp interpole motor by means of which the various operating shafts may be moved.

On the left side of the board are four horizontal shafts, one each for red, white, blue and amber lamps. On each of these shafts switch and dimmer connections are provided for the footlights, proscenium, ceiling and border lamps and pockets, and a similar arrangement is installed on the right side of the board. The horizontal shafts are carried across the board from end to end, and are fitted in each case with a clutch in the central panel by means of which both the right and left sides of the house for any color may be operated together or separately. On each side of the board at the right and left of the central clutches are clutches connected with rods driven through worm and screw gearing by the motors above mentioned. Two sets of driving rods are provided for each motor, one rod on each side moving upward, while the other descends. By means of the clutches any horizontal shaft can be connected with the driving rods to move either up or down without interfering with the movements of the other shafts, and if desired all four shafts on each side of the board can be moved up or

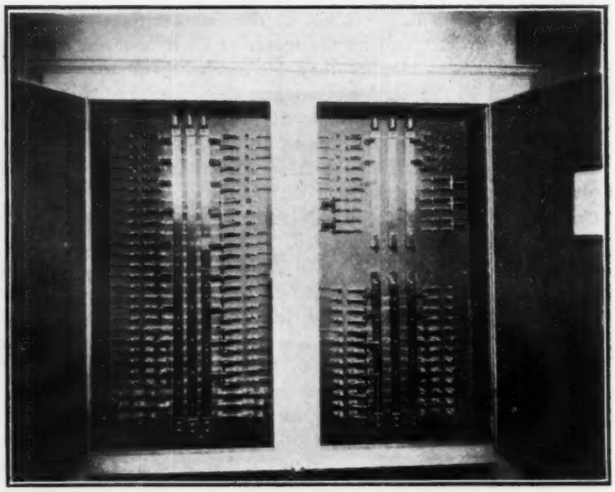


Fig. 7—Upper Part of Ticket Office Board.

down by the same motor simultaneously. The number of combinations available is sufficient to meet a wide range of illuminating situations on the stage. Any switch or dimmer handle may be operated with the horizontal shaft on which it is carried or held free from movement while the shaft revolves and be manipulated by hand.

If desired, the lamps in any part of the house or stage may be dimmed while those in another portion are increased in brilliancy; or the entire equipment may be changed with possibly a few slight modifications in intensity of lighting at some local point. The switchboard operator has full control of the dimmer and switch motors from his position at the front of the stage. A push-button panel is installed directly

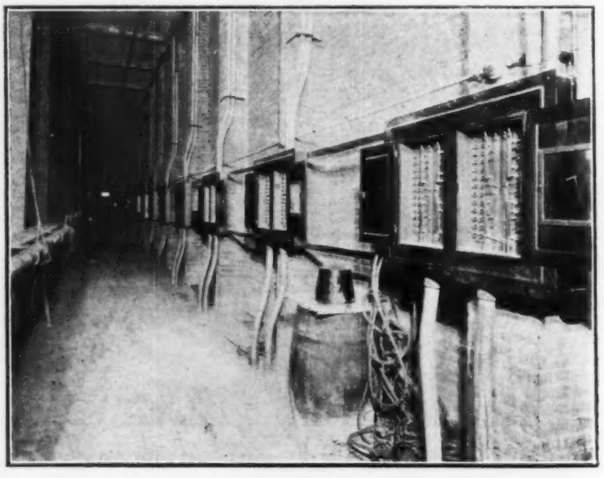


Fig. 8—Fly Gallery and Border-Light Cabinets.

in front of the operator's seat with four buttons for raising and lowering the speed of the driving shafts connected with the motors. A push switch is also provided in this panel for the motor circuit, so that overheating will be prevented when the motors are not needed. The links connecting the driving rods with the motor-driven screw are connected

by removable pins so that the rods may be disconnected from the motor in case of accident to it. The motors are designed to be thrown directly across a 110-volt line without external resistance, each being reversible and equipped with a dynamic brake. Brass shaft bearings are provided. The bell crank levers are designed to permit removal of any lever without disturbing the rest of the installation. The vertical rods

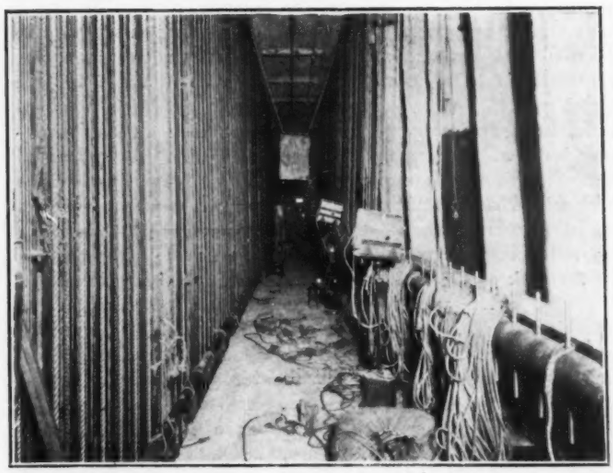


Fig. 9—Lower Right-Hand Fly Gallery, Showing Portable Electric Spot Lights.

leading to the dimmers are provided with counterweights which are adjustable, to balance the weight of the rods.

There are 168 dimmer plates installed in the compartment below the stage switchboard, besides two cast grid dimmers which are hand-operated in connection with the auditorium service. All dimmers and the operating mechanism were supplied by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., and are controlled from the main switchboard.

Two main switches are provided for each bus for each color, thus providing for the control of all the lamps of each color on each half of the stage without the necessity of operating the individual switches. In addition there are three main switches, one controlling all the circuits for arc lamps on the stage, one

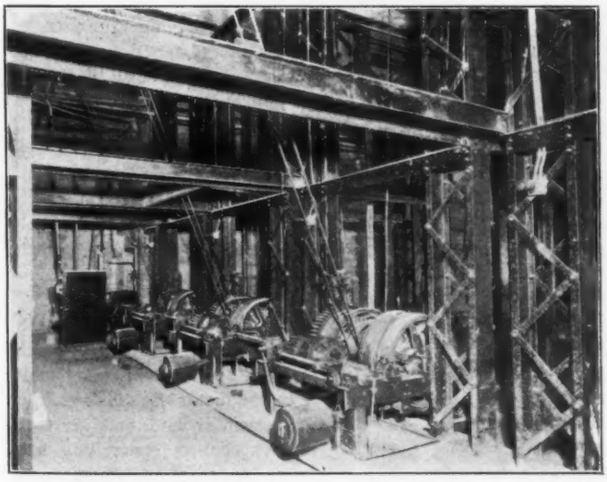


Fig. 10—Driving Mechanism for Three Front Bridges.

controlling all incandescent lamps on the stage, and one controlling all auditorium lights, A bar with adjustable latches operated by a pedal located in a convenient position is used to open these main switches. By properly setting the latches any switch may be opened by operating the pedal. The switches are closed by pneumatic cylinders, a system of valves with one master valve allowing the necessary combinations. A pressure of 80 lb. per square inch is used upon the air cylinders.

Each dimmer can be stopped at any point in the travel of the motor-driven shaft, and in this way any desired intensity of illumination can be secured and carried throughout any necessary period of time. The arrangement is not automatic for a very gradual increase or decrease of light, but the operator can make very slow changes in the position of the dimmers by making frequent stops in the movement of the motors. No variable-speed equipment was installed.

There are seven borders, each 65 ft. long, and wired for four colors. Each half of each border may be operated independently of the other, and is equipped with 376 80-watt tantalum lamps fed by slow-burning weatherproof cables carried into the center of each border. The arrangement of two sections of each color across the stage makes it possible to obtain a light gradation from darkness to full brilliancy not only from one side of the stage to the other, but also from the back to the front of the stage. Cut-out cabinets for the border circuits are located on the first fly gallery. From these cabinets conduit is run to the roof over the stage and then along the trusses to points above the borders, from which flexible connections are dropped to the lamp-circuit distribution centers. The cables are long enough to allow the borders to be lowered

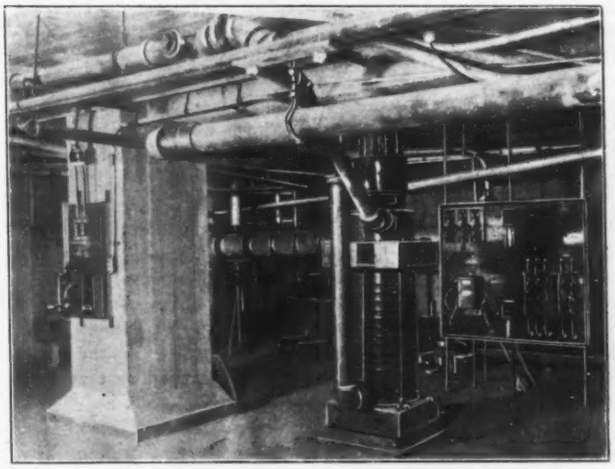


Fig. 11.—Vacuum Cleaner and Edison Service Board on Rear.

to the floor of the stage, and the slack is taken up as the borders are raised by systems of counterweights. The border lamps are carried in galvanized-iron troughs of elliptical shape, the lamps being installed in double rows with alternating colors in the bulb sequence. The footlights are also made up in double rows of 80-watt tantalum lamps, 240 being installed. The stage borders and footlights thus call for 2872 80-watt lamps. A grating is installed in the stage floor behind the footlights over a small trench carrying a perforated steam pipe, from which clouds of ascending vapor issue in setting certain scenes.

The orchestra lamps are taken from single-lamp floor plugs set in the orchestra pit, there being 92 receptacles, and inasmuch as the orchestra floor has an up and down movement of 8 ft. the outlet boxes are connected by means of flexible cable to other boxes in the pit below. All receptacles under the stage are equipped with shade holders and metal shades to prevent the light showing above the stage when the traps are open. The receptacles for all parts of the stage and orchestra are mounted in cast-iron boxes of sufficient depth to pass through the floor, permitting adjustment of conductors from below. A special feature of the equipment is the desk of the orchestral conductor, shown in Fig. 3. This outfit consists of a polished wooden case equipped with a music rack illuminated by incandescent lamps mounted in reflectors at each

end, and various electric switches and signaling apparatus. Beneath a small cover at the left center of the desk are mounted four time-beating keys resembling the keys of a piano, but attached to electric contacts which flash one or more of four incandescent lamps mounted in transparency boxes at seven points in the house. These lamps are installed in compartments numbered from 1 to 4, so that by pressing the proper key the conductor can signal not only the beats of his bâton to parts of the stage and fly galleries which may be obscured from his vision, but also the beat upon which instrumental or vocal music is to begin. With concealed chorus work this system prevents any lagging behind the orchestra. There are five fixed and two portable time-beater indicating boxes in the theater. The conductor's desk also contains a three-way switch and lamp by which cues are given and received from the stage manager. A push button is also provided in the conductor's desk which signals the movements of the curtain. A buzzer-signal service in connection with the stage manager is also provided, and the conductor is furnished a telephone set of the portable type with transmitter and receiver mounted upon a single handle, which also contains the ringing buttons. This telephone connects by private line with the stage manager and opera house library. The curtain button is equipped with a small metal shield to prevent inadvertent operation. The time-beater circuit is operated by 10-volt service furnished by a motor-generator set in the engine-room. The conductor's desk is portable and the lighting reflectors are adjustable both vertically and horizontally.

The illumination of the auditorium is accomplished by a handsome center chandelier in the form of an inverted cone, equipped with 173 tungsten lamps. Forty-seven of these lamps are of the 40-watt size and the balance are 25-watt lamps. Fifty-three of the chandelier lamps are controlled by a solenoid switch operated from the ticket office, as well as from the stage board, and the remainder are operated from the stage switchboard only. The chandelier is finished in brass, and is equipped with a tackle by which it may be lowered to the floor for inspection and adjustment of lamps. The distribution box for the chandelier is located in the dead space just above it, and all circuits are arranged so that they can be easily disconnected when the fixture is lowered.

Above the chandelier is an installation of ring lamps supplied from cabinets located above the auditorium ceiling. The auditorium lighting circuits are carried from the stage switchboard under the stage toward the front and thence to the proscenium wall, whence they rise to the attic level and then drop to the local distribution cabinets. On the under side of the second balcony a number of five-lamp clusters of incandescent lamps are provided for general lighting, and in front of the beams, concealed by the latter from the direct vision of patrons in the first balcony are rows of incandescents, part of which are used as emergency lamps and controlled both from the stage and the ticket office. These lamps are in the main frosted Gem 50-watt units, there being 110 under the first balcony and about the same number on the ceiling of the second balcony. The boxes are all lighted by 50-watt metallized-filament lamps placed out of vision of the occupants behind the beams. In general, two or three lamps are provided for each box. Two tiers of boxes run all around the auditorium, in addition to which there are 12 loges near the stage on each side of the auditorium. Corridors, hallways and stairways are, in general, lighted by small chandeliers or bracket fixtures. The exit signs are supplied with electricity from the ticket-office board. Each sign consists of two 220-volt lamps placed in multiple across the 110-volt service of the house, in order to secure proper dimness. These lamps are installed behind a panel of red glass suitably marked, and are not separately metered. All distribution boxes are of iron with slate linings and backs. The marquise lamps are supported on angle irons with condulet fittings, and are arranged for subdivided operation, so that the ticket agent can throw on a few for the convenience of ticket purchasers in the late afternoon. They are controlled by a solenoid switch in each circuit.

All conduit in the auditorium above the basement and in the right wing of the stage is concealed. Throughout the basement, attic, balance of the stage and left wing it is exposed. There are 15 four-gang Kliegl receptacles for incandescent bunch lamps and 15 two-gang receptacles for arc lamps cut in the floor of the stage, all being of 15-amp capacity and connected to the cut-out cabinets by separate circuits of No. 4 wire. Each receptacle in the four-gang pockets is intended to be used with but one color of lamps, and the circuits to the receptacles are fed through dimmers. The dimmers for the bunch pockets consist of four plates each, the plates being of different capacities and connected to the circuits through single-pole knife switches, making it possible to dim any groups of lamps of from 20 to 130 lamps in steps of 10 lamps each. The arc pockets have no dimmers. There are two 50-amp receptacles set in the floor of the stage, one being on each side. These are connected through switches on the stage board to the busbars on the back of the main switches. There are three circuits of 150 amp to 200 amp capacity controlled by switches on the stage board; one runs to a point at the left of the stage, the second to a point under the right-hand side of the stage, and the third to a point on the gridiron for supplying any special group of lamps or other apparatus which may be needed. In the lower fly gallery on each side are four-gang, 50-amp Kliegl receptacles for arc lamps, which are controlled by switches on the stage board. In the middle box on the second tier is a distributing panel board with four 50-amp fused branches fed by No. 4 wires from the stage board, for stereopticon work in ultra-spectacular performances. There are also two pockets provided for this service at the right and left of the first balcony, and also in the center front of the latter and of the second balcony.

In all artist's dressing-rooms and in chorus rooms Simplex combined grease-paint and curling-iron electric heaters are installed. Drop lamps are liberally installed in front of the dressing mirrors. For the heaters circuits are run in metal conduit on the underside of the table to the switch and apparatus. The maximum load so far noted on the plant is 2700 amp at 115 volts.

Elaborate provision is made for telephone and bell signaling in the building. In general, energy for this service is provided by the motor-generator installation above mentioned, a 12-volt service being used. A 45-station watchman's clock system is in operation, and the bell system includes buzzers in the principals' rooms, 17 in number; upper fly gallery, right and left; lower fly galleries, conductor's desk, stage switchboard and at four points under the stage. Bells are installed in chorus, ballet, supers' and musicians' room, with button control at the prompter's position. Lamps of 8 cp are used for giving cue signals from the stage manager's headquarters, etc., these lamps being carried under the stage as well as into the fly galleries. An intercommunicating telephone system is installed, and the building also has a private branch exchange of the New England Telephone & Telegraph Company's service.

At the stage manager's position in the wing is located a special fire-alarm box of the Boston system. Other provisions here are a cue-button board; signal-bell service connecting with dressing-rooms; telephone service to conductor, fly galleries, the house in general; thermostatic annunciator and bell service; front stage, bridge operating levers; cabinet controlling arc pockets in stage; sprinkler alarm, time-beater signal and watchman's clock service.

The electric wiring was installed by M. B. Foster & Company, Boston. The general contractor for the building was Mr. George W. Harvey, Boston. The auditorium lighting fixtures were supplied by Edward F. Caldwell & Company, New York, and the E. H. Tarbell Company, Boston, supplied fixtures behind the proscenium wall. General Electric, Northern and Garwood motors are used.

BLANKENESE-OHLSDORF HIGH-TENSION, SINGLE-PHASE RAILWAY.

By GUSTAV DIETL.

IN the description of the Hamburg single-phase suburban traction system which appeared in these columns recently (Nov. 18, 1909) the distinction between the old and the new equipment was not brought out as forcibly as it should in order to avoid confusion. The writer has therefore undertaken to point out the characteristics of the new equipment so as to eradicate any erroneous impressions.

The first experiments with single-phase traction in Europe were made in 1903 by the Allegemeine Elektricitäts-Gesellschaft in co-operation with Geheimen Ober-Baurat Wittfeld of the Prussian State Railways, and the State placed the Niederchöneweide-Spindlesfeld Line at the disposal of the company for this purpose. The results with the Winter-Eichberg system on that line were such that the Prussian State Railway decided to equip the Blankenese-Ohlsdorf line with the single-phase system, using electricity at a pressure of 6000 volts and a frequency of 25 cycles. The orders for the line equipment and the power station were divided between several firms. The first order for the rolling stock comprehended 60 motor cars, 54 of which were equipped by the Allgemeine Elektricitäts-Gesellschaft and 6 by the Siemens-Schuckert Works. The electric lines were placed in service in January, 1908, and traffic increased so quickly that in the summer a second order for 25 motor cars was placed with the Allgemeine Elektricitäts-Gesellschaft. In 1909 25 more cars were ordered, 17 of which were equipped by the Allgemeine Elektricitäts-Gesellschaft and 8 by the Siemens-Schuckert Works. The railway now possesses a total of 110 motor cars, 96 of which were equipped by the Allgemeine Elektricitäts-Gesellschaft.

The old 54 motor cars have three single-phase Winter-Eichberg motors of 115-hp one-hour rating. The complete weight of the cars is 71 tons. They have been described several times, so that it is not necessary to go into details regarding them. The new motor cars are equipped with two single-phase Winter-Eichberg motors of 200-hp one-hour rating. The electrical equipment and the mechanical part of the coaches have been simplified, so that it was possible to reduce the weight of a complete car to 61.5 tons, the electrical equipment alone weighing 13 tons. The motor-coach is of the twin-car coupled type. Each half has on one end a two-axle truck and on the other end near the short-coupling a single running axle. The length of the car body of one-half is 14 m, the width 2.6 m; the total length over buffers is 29.65 m. The coaches are of the compartment type with side doors. Each half has two second-class, four third-class, one baggage and one motorman's cab. The compartments of the same class in each half are connected together. The baggage compartment possesses folding seats, so that they can be used by passengers as well as the motorman's cab, when not required for their respective purposes. The controlling apparatus is compactly arranged on the left side of the motorman's cab and can be put under lock and key when the cab is used by passengers.

The truck has a wheel base of 2.5 m, and the diameter of the

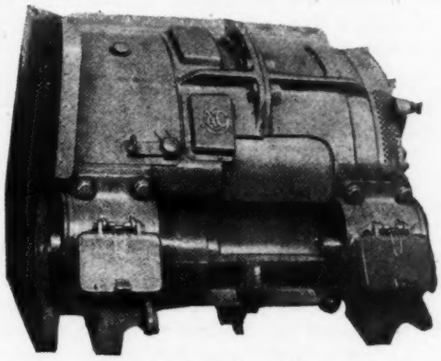


Fig. 1—Winter-Eichberg Single-Phase Railway Motor

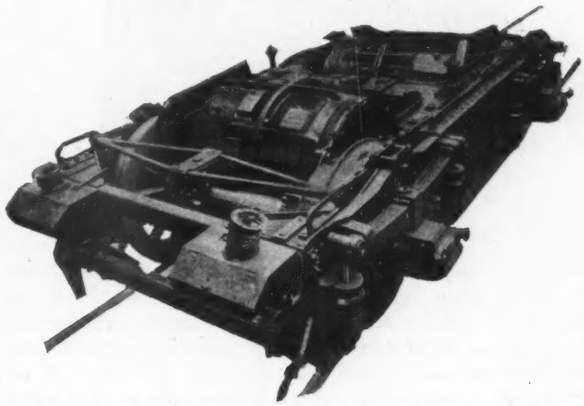


Fig. 2—Truck Equipped with Two Single-Phase Motors.

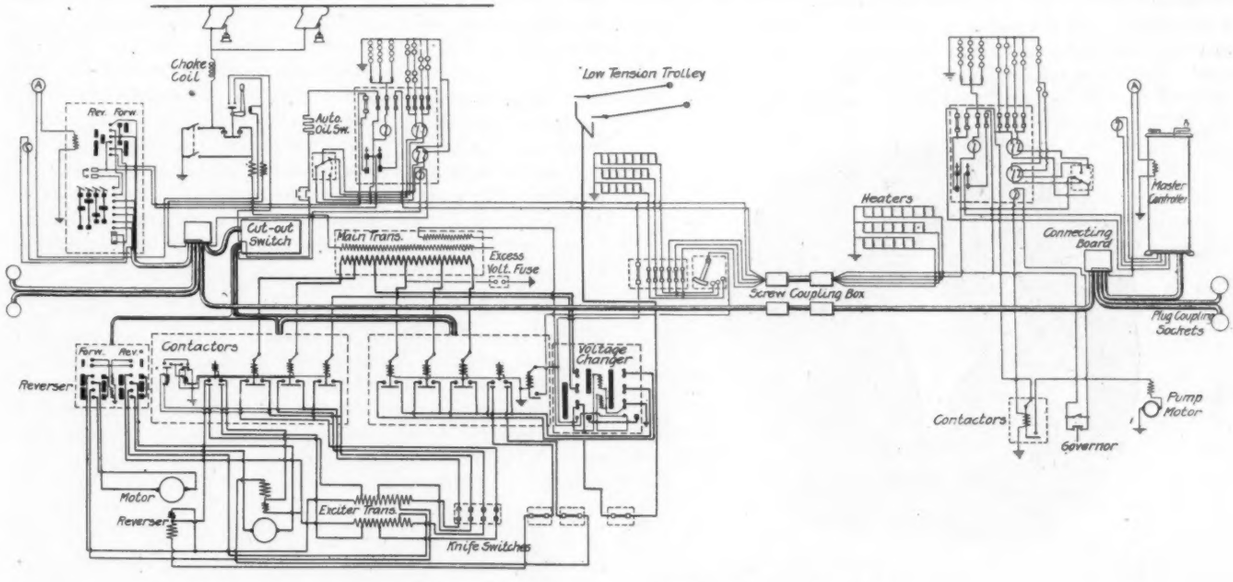


Fig. 3—Complete Wiring Diagram of Single-Phase Motor Car.

wheels is 1 m. The motors are placed together in one truck, the second truck carrying the motor compressor.

The electrical equipment is designed for an average line pressure of 6000 volts, single-phase current and for a frequency of 25 cycles, but it is also adapted for a pressure of 300 volts near the car sheds. As previously stated the motors have an output of 200 hp at 500 r.p.m. during one hour. The continuous rating is 100 hp; the weight, including gear case, 3300 kg; the gear ratio, 1:3.05. The single-phase stator winding has six poles. The working winding is in series with an interpole

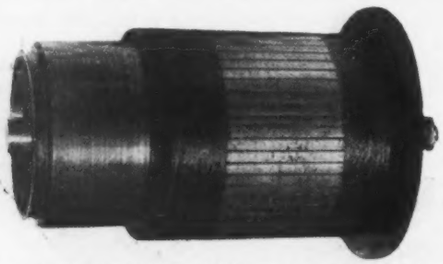


Fig. 4—Rotor of Winter-Eichberg Single-Phase Motor.

winding, and each of the poles consists of three coils. Every second pole has a commutating coil. For low speeds the commutating coils are in series with the working coils. For high speeds the commutating coils receive energy at a certain pressure from taps on the exciter transformer. The electrical design of the motor permits large air-gaps; and while a motor has an air-gap of 3 mm the power factor remains nevertheless almost unity. The rotor winding is a normal direct-current winding, and on the pinion side the rotor has a centrifugal ventilator, which forces the air through the inner side of the commutator and through holes going through the rotor iron, but the air does not come in contact with current-carrying parts of the commutator and the windings. The motor possesses eight brush holders, six of which are short-circuited on themselves and two are used for exciter brushes.

Fig. 3 shows a diagram of connections. The high-tension current collected by bows from the trolley wire goes through a choking coil, an automatic oil switch and a main transformer to earth. A lightning arrester and a high-tension fuse are not used. Each car has one main transformer for both motors. It is of the oil-insulated type with one high-tension coil and

Fig. 5—Stator of Winter-Eichberg Railway Motor.

two low-tension coils; one of the latter has six taps and supplies energy at different pressures up to 780 volts for the motors; the other supplying energy at 300 volts for the operation of the contactors, the reverser, the car-lighting circuits, the heating circuits and the air compressor. Each motor has one exciter transformer. There are five running steps, for which the motors are fed with energy at different pressures from the main and the exciter transformers. These different circuits are effected through the electrical operation of the contactors by means of the master controller.

Eight of the 42 new cars have high-tension energy collectors of the pantograph type with a bow on the top. All other cars have the ordinary bows for high-tension work with an upper hinged part; the second type of collector has separate bows for each running direction, which are changed at the terminal stations. Both kinds of collectors, the pantograph type and the ordinary bow, are raised and maintained in the high position by compressed air. The small movements of the bows during the run are picked up by the bow springs. Each motor-coach has two sets of high-tension energy collectors, which are placed on the same part of the car, which is situated above the truck carrying the motors. Besides the high-tension energy collectors each car has two ordinary trolleys, one on each side for the low-tension district near the car sheds. The train service is made up of single motor cars during the hours of light traffic; but during the rush hours, the trains consist of two and more cars, all of which are motor cars.

LONG UNDERGROUND TELEPHONE LINES ON PUPIN SYSTEM.

By A. Ebeling.

THE great havoc wrought by the snowstorms of November last in Germany, especially in the environs of Berlin, on the overhead telegraph and telephone wires, gave rise to numerous articles in the daily press in which the question was discussed as to whether it were not possible to obviate by the use of underground cables the disturbance to traffic caused thereby, but the conclusion generally reached was that, though long telegraph circuits could be, and for some years past had been, placed underground, it was not possible for efficient commercial traffic to do likewise with telephone circuits. The positive proof is here given that not only is it possible to lay long telephone lines underground which would be more efficient than overhead wires, but even ultimately more economical. This conclusion has been arrived at by the Siemens & Halske Company as the result of actual experiments on the loading of cables with inductance according to the Pupin system, which has been attended with the most striking results, and the benefits of which have caused its rapid introduction in most countries, especially for the industrial districts of the Lower Rhine and Westphalia, and for cable lines in lengths of several hundred kilometers in North America. The special series of experiments here detailed were undertaken in order to clear up apparent differences between the actual observed values of the attenuation coefficient and those given by calculation from the electrical data of the circuit.

The attenuation coefficient determines the efficiency of any telephone circuit. The general formula for the attenuation coefficient per kilometer is given by the expression,

$$\beta = \sqrt{\tfrac{1}{2}\left[\sqrt{(G^2+p^2C^2)\,(R^2+p^2L^2)}+GR-p^2CL\right]}. \qquad (1)$$

where $p = 2\pi f$, f being the frequency in cycles per second; R and L the effective resistance and inductance of the loop, and G and C the leakage conductance and capacity, taken wire to wire per kilometer. In circuits with high inductance, for example, conductors loaded with Pupin coils, this expression can be simplified and reduced to the form given by Professor Breisig:

$$\beta = \frac{R}{2}\sqrt{\frac{C}{L}} + \frac{G}{2}\sqrt{\frac{L}{C}} \qquad (2)$$

L here includes the value per kilometer of the inductance added by the coils. The leakage conductance G is the reciprocal of the apparent insulation resistance and has been generally assumed as negligible seeing that the insulation with direct current, especially in the case of the paper cables, is of the order of thousands of megohms; hence if $G = 0$, the two expressions above become

$$\beta = \sqrt{\tfrac{1}{2}pC\,(\sqrt{R^2+p^2L^2}-pL)} \qquad (3)$$

and

$$\beta = \tfrac{1}{2}R\sqrt{\frac{C}{L}} \qquad (4)$$

Béla Gáti was the first to announce the fact that in ordinary

paper-insulated telephone cables a very much lower value of insulation obtained for alternating currents at frequencies comprised within the limits of human speech, and in the cables he tested he found that at 2000 cycles per second the insulation resistance was about 0.1 megohm, or only about one-ten-thousandth of the value given by the usual direct-current measurement. These measurements were obtained by the alteration in the resistance of a very thin wire, heated by the alternating currents at the frequency in question, observed first on a short piece of the cable and then on a condenser of the same electrostatic capacity, with a resistance in parallel, adjusted until the current was the same in the two cases. Professor Breisig has also directed attention to the effect of this leakage value on the attenuation coefficient in cables loaded with Pupin coils.

While Béla Gáti found a leakage conductance, as above stated, of about 10 micromhos for paper cables, Professor Breisig, by calculation from tests made on a submarine cable, found a leakage conductance of 2.3 to 3.8 micromhos per kilometer. The construction of this cable differed, however, from the normal, in that the copper-stranded conductors were close wound with layers of fine iron wires. Attention may be at once drawn to the fact that in the comparatively short Pupin coil loaded cables laid by the Telegraph Administration, conductors of light section have been employed and the attenuation coefficient is fairly high, and that in such cases leakage plays but a very small part; but as soon as the problem is entertained of laying long cable lines, heavier conductors will have to be adopted, so as to reduce the attenuation coefficient and that then leakage may play a prominent part.

Table I was calculated from certain assumed data so as to exhibit this influence, the values per kilometer being $L = 0.1$ henry, $C = 0.04$ mf., while the leakage conductance has been taken at 10 and 3 micromhos, as above found in definite instances, and also at 1 and 0.5.

The resistance of the conductor, including that of the loading coil, is taken at 70 ohms and 10 ohms for the two sets corresponding to conductors of 0.8 mm and 2 mm diameter, respectively.

TABLE I.—ATTENUATION CONSTANTS OF CABLES WITH DIFFERENT VALUES OF LEAKAGE CONDUCTANCE.

R ohms	L henry	C mf.	G micromho	β_r	β_g	β	$\triangle$ Per Cent.
70	0.1	0.04	10	0.0221	0.0079	0.0300	36
"	"	"	3	"	0.0024	0.0245	11
"	"	"	1	"	0.0008	0.0229	4
"	"	"	0.5	"	0.0004	0.0225	2
10	"	"	10	0.0032	0.0079	0.0111	247
"	"	"	3	"	0.0024	0.0056	75
"	"	"	1	"	0.0008	0.0040	25
"	"	"	0.5	"	0.0004	0.0036	12

The column headed β_r gives the value calculated from the first member of formula (2), when leakage would be neglected. β_g, that calculated from the second member of that formula, the next column contains the sum of these two, and, therefore, the true value, while the last gives the percentage difference due to β_g. With the resistance of 70 ohms it is only the 10 micromhos leakage conductance that introduces any considerable alteration, while, on the other hand, with the resistance of 10 ohms it is only the leakage conductance of 0.5 that is of negligible import. The values here assumed were chosen intentionally, so as to exhibit the subject in a convincing manner, but with the lower resistance the influence of leakage would be improved by reducing the inductance, as shown by Luschen. By the choice of suitable coils some decrease in the β_g term can be secured without great increase in β_r. Professor Breisig's figure of about 3 micromhos agreed satisfactorily with the values deduced by other measurements from the attenuation coefficient on some lengths of cable, but this was an exceptionally high figure and, we believe, that for paper cables in general their leakage may be taken as very small, if not completely neglected. There remains the further hypothesis that, even if the leakage be negligible, and differences between the calculated and observed values of the attentuation still exist, such may be ascribed to some unknown losses in the coils themselves, so that investigation of their leakage was also necessary. It was clearly obligatory to find some reliable method of directly measuring the leakage itself, even when its amount was very small.

The solution of the problem was found by Dr. Adolph Franke and is based on the method and form of apparatus described in his thesis for the Doctor's degree, published in 1891. This paper contains a full description of a special form of high-frequency alternating-current machine, which he, being at that time in the service of the Government Telegraphs, had had constructed at their instance and with which he conducted a full series of measurements on the electrical constants of telephone lines and apparatus. The same machine and methods have also been employed by Dr. Breisig in his valuable researches.

In the course of his general treatment of the subject, Dr. Franke states the following simple equation as applicable to circuits if of no great length,

$$\frac{I}{E} = R = Gl + j\,2\pi fCl \qquad (5)$$

where I and E are the current and voltage at the beginning of a line insulated at the far end, G the leakage conductance, C the capacity both per unit length, f the frequency and l the length of the circuit.

Introduce into the circuit of the alternating current in series with C_2 the short length of twin-insulated conductor with the opposite ends free, an adjustable condenser C_1 which has no measurable leakage, and adjust the capacity until the voltage across its terminals is the same as across the cable. Then, at the terminals of the condenser,

$$\frac{I_1}{E_1} = j\,2\pi fC_1, \qquad (6)$$

and of the cable,

$$\frac{I_1}{E_2} = G + j\,2\pi fC_2, \qquad (7)$$

where G and C_2 are the values for the length under test, the current I_1 being the same in both.

Hence,

$$\frac{E_1}{E_2} = \frac{G + j\,2\pi fC_2}{j\,2\pi fC_1} = \frac{G}{j\,2\pi fC_1} + \frac{C_2}{C_1}$$

but with voltage of true sine curve,

$$E_1 = Ke^{j2\pi ft}$$

and

$$E_2 = Ke^{j(2\pi ft + \theta)}$$

hence,

$$\frac{E_1}{E_2} = e^{-j\theta} = \cos\theta - j\sin\theta = \frac{C_2}{C_1} - j\frac{G}{2\pi fC_1}$$

and, therefore, $\cos\theta = \dfrac{C_2}{C_1}$ and $\sin\theta = \dfrac{G}{2\pi fC_1}$, where θ, the phase difference between the voltages at the condenser and cable terminals, is a very small angle, and, therefore,

$$G = \theta\,2\pi fC_1. \qquad (8)$$

The angle θ is usually of the order of a few minutes, and as the original machine did not permit measuring such a small angle within the requisite limits of accuracy, a special one was constructed with the necessary modifications so as to allow a finer reading, the details being worked out under the direction of Mr. A. Becker. The figure for the leakage on long lines deduced by the indirect method of measurements conducted by the testing department of the Telegraph Administration were not rendered any more accurate by the use of this modified machine.

From the value of G, for the length of cable tested, the value per kilometer is given by simple proportion, and the angle θ is a constant for any short length of the same type of cable. Thus, with one type of cable, according to the measurements, the angle θ increased from 12 minutes to 13 minutes when the length of cable was increased from 75 m to 150 m, and in all

measurements these are approximately the limits of the lengths that were tested.

As the angle θ was also found to be constant for different frequencies for the various cores tested, it appears that the leakage is directly proportional to the frequency. A control of the correctness of this method was furnished by testing a condenser in parallel with a known constant resistance, as G and C, being both constant quantities, θ would vary inversely as the frequency. Table II gives the results of the measured and calculated values for a condenser of 0.00605 mf. in parallel with an alcohol resistance of 6.6 megohms.

TABLE II.—COMPARISON OF MEASURED AND CALCULATED VALUES OF ANGLE.

Frequency, cycles per sec.	θ in Min.	
	Measured	Calculated
512	25	26.8
640	20	21.8
896	13	15.3
1,100	12	12.5

The agreement between these figures is satisfactory as the limit of error in the measurement of the angles was about 2 minutes. In the case of the cable, which was used for the most important experiments, and which was specially adapted to the Pupin system of loading, the leakage conductance per kilometer at 900 cycles per second was 0.45 micromhos, the variation in separate conductors being less than 4 per cent. In two gutta-percha insulated cores, which happened to be available, but not of usual submarine cable dimensions, immersed in salt water, the leakage conductance per kilometer at 900 was 9.3 micromhos and 10.6 micromhos, respectively, which agrees with the value found by Professor Breisig on a gutta-percha cable having cores with continuous inductance, where, also, the increase of leakage with capacity is noticeable, but in whose figures for paper cable no such alteration appears.

Our tests, however, of paper cores with conductors of 1.5 mm diameter show a maximum leakage conductance per kilometer of 0.74 micromhos at 900 volts. Numerous tests were made on various types of cables and conductors which give promise of great interest as to the nature of leakage, but the account of these must be reserved for a future occasion. This same method can also be applied to the testing of the inductance coils themselves, as they may be treated as conductors with evenly distributed capacity. One type of coil, inductance 0.2 henry, gave a leakage conductance of between 0.036 micromhos and 0.04 micromhos, while in another type of the same inductance 0.21 micromhos to 0.28 micromhos was found, both of which types have been used in the loading of cables recently laid and may be taken as of normal manufacture, so that a very small leakage is evidently obtainable in such coils. Being now in possession of all the necessary data for the leakage of cable and coils, it was possible to check the agreement between theory and practice for Pupin's formula by actual measurement, introducing the correction, of course, of his sine rule, which gives the relation between the values obtained on circuits containing continuous and distributed inductance. For this purpose it was necessary that the measurements of the attenuation coefficient should be accurately effected, and though the method used by the experiment department of the German telegraphs was available, it labors under the disadvantage of requiring a long and tedious evaluation of the figures given by the readings, and for our ends a method, if equally reliable, was desirable which would allow a speedy calculation, because, as may be imagined, a very long series of tests had to be made before reaching the simple results ultimately attained.

Had it not been possible to measure the leakage conductance itself directly, then any difference between calculation and observation would be ascribed to some variation in the leakage conductance, and in spite of many special experiments, the conclusion had been arrived at that an accurate value of the leakage conductance was not obtainable by the indirect method previously stated, as so many different factors entered simultaneously into the question. A simple method of determining the attenuation coefficient is afforded by the measurement of the current at the near and far ends of a circuit, provided it be of sufficient length. Most of the readings were taken by oscillograph, which recorded simultaneously the curves of the two currents, from the amplitude of which the intensities could be determined. By the equation $I_e \div I_b = 2\,e^{-\beta l}$, where these are the currents at the beginning and end of the line of length l, the value of β is readily calculated. The length of line was usually about 100 km, and the results given by this method and that of the Government department were in thorough concordance, when the line was of sufficient length, as above stated. Tests were also made with the Franke instrument by measuring the voltage at the terminals of non-inductive resistances interposed at the two ends of the line and thereby determining the two currents, but this method had the disadvantage of introducing high resistances into the circuit as compared with the extremely small resistance of the oscillograph, but both methods gave equally concordant and sufficiently reliable results. The main series of tests were made on a 10-pair, paper-insulated cable with 0.8 mm conductors, which was available in separate equal lengths of 1300 m, so that an even distribution of the inductance coils, i.e., at 1300 m apart was obtained and the frequency was generally 900 cycles per second, which may be taken as representing the mean tone of the human voice, but measurements were made at other frequencies also, and in Table III are contained the values obtained at 500 cycles, 900 cycles and 1200 cycles per second, at which observations could be made with the greatest accuracy and which cover all practical requirements. This table gives the frequency and the mean values of the effective resistance, inductance, capacity and leakage conductance all measured for a length of 1 km of the twin core, taking into account the separate values for cable and coils; the attenuation coefficient β_r, if only the first member of equation (2) is used, and which may be considered the ideal value of β, the β_p, which includes the increase due to Pupin's sine rule, and then β_g, taking into account all the factors including leakage and which is the correct value given by calculation. The last column, β_m, gives the values found by actual measurement. The agreement between these last two columns is extremely close.

TABLE III.—RESULTS OF EXPERIMENTS ON TWIN CORE CABLE LOADED WITH PUPIN COILS.

f	R ohms	L henry	C mf.	G micro-mho	β_r	β_p	β_g	β_m	
								A	B
500	71.4	0.154	0.0308	2.27	0.0160	0.0160	0.0163	0.0162	0.0162
900	74.0	"	"	0.48	0.0166	0.0167	0.0173	0.0177	0.0173
1,200	76.7	"	"	0.64	0.0172	0.0175	0.0182	0.0187	0.0184

The figures under A and B are for cables equipped with coils of similar form, but of slightly different construction, the leakage conductance of which was very small and, in fact, equal to that of the first type of coil previously mentioned—that is, about 0.04 micromhos. Under B are given the mean values of observation made on several days both by oscillograph and Franke's machine, and under A the results of one set of observations alone, and in this case also the difference between calculation and measurement is extremely slight. The difference between β_g and β_p reveals the effect of leakage conductance and varies for the frequencies given between 2 per cent and 4 per cent, but, as already stated, leakage conductance would play a much more conspicuous part in cable with heavier conductors. On referring back to Table I it is seen that the leakage conductance here measured corresponds to about the value of 0.5 micromhos, and is thus of little moment; and even with a leakage conductance of 1 micromho the increase in attenuation could, as already mentioned, be counteracted to some extent by a reduction of the inductance. This treatment of the question, where high leakage obtains, has been considered by Luschen and Devaux-Charbonnel, but

with paper cables this difficulty does not enter, as it is possible in these cases to secure very small leakage. Other measurements were made on a cable actually in operation with conductors 0.9 mm, but the leakage conductance of which had not been measured before the cable was laid, and in Table IV are contained the values of β, given by calculation from the electrical data, omitting both Pupin's sine rule correction and the leakage, column 3 gives the figures corrected for the former omission and column 4 the actual measured value, and by application of equation (2) it is easy to determine the leakage conductance, which is, of course, the sum of that of cable and coils and these are set forth in the other columns, 4 giving the value thus calculated, 5 the same under the assumption that the leakage conductance is proportional to the frequency, and taking 0.59 at 900 cycles per second as the basis. These coils were of similar construction to type 2, above mentioned, with a leakage inductance of 0.25 micromhos at 900 cycles per second, and the value per kilometer is given in column 7, while the difference in column 8 gives the leakage conductance of the cable alone, which is shown to be very small and at the same time to be in accord with the actual

TABLE IV.—ATTENUATION CONSTANT FOR DIFFERENT VALUES OF LEAKAGE CONDUCTANCE IN MICROMHO.

f	2	3	4	5	6	7	8
500	0.0168	0.0169	0.0172	0.35	0.33	0.07	0.28
900	0.0172	0.0175	0.0180	0.59	0.59	0.13	0.46
1,200	0.0179	0.0186	0.0194	0.94	0.84	0.24	0.70

values, ascertained on the experimental cable, given in Table III; but this is not remarkable, as these cables were of the same special construction, though these extremely close values are no doubt partly fortuitous. The results of our experimental research may, therefore, be stated shortly as follows:

1. Cable loaded according to Pupin's system gives results absolutely in accordance with theory.

2. Cables manufactured by Messrs. Siemens & Halske specially for the application of this system have such low values of leakage conductance that the influence thereof on the attenuation coefficient is negligible.

3. A short length of cable is sufficient for the accurate measurement of the actual leakage conductance.

4. Inductance coils with a negligible leakage conductance can be secured.

This data, the gaining of which was no mean labor, furnish the means of giving a definite decision as to the length of cable which it is possible at the present time to operate when loaded according to the Pupin system.

Adopting the electrical values, which are now available for calculating the attenuation coefficient, it may be stated that with coils of the best form, and cable properly constructed, efficient operation can be secured on trunk lines of 1000 km in length without a greater diameter of the conductors than 3 mm. All important trunk lines in Germany would be shorter than this.

It must be remembered that this conclusion is due to the fact that circuits composed of cable alone can be worked with a less volume of sound than overhead circuits, because the latter, liable as they are to great changes in insulation resistance, never afford the efficiency theoretically allowed and are also much more subject to external disturbances, so that heavier conductors must be employed than would be otherwise necessary, while in a cable this extra reserve of power is not required, because the efficiency once established is always the same. Special experiments conducted by Messrs. Siemens & Halske have shown that for long telephone lines a value of βl between 3.5 and 4 is not too great. This product of attenuation coefficient and length, first introduced by Professor Breisig as the efficient factor, and termed by him the "attenuation exponent," gives a clear picture of the value of any circuit in a simple form. An increase in the size of conductor will, in general, decrease β and, therefore, allow an increase of the length the same value of βl. It was a simple matter, therefore to arrange different values of βl in the testing-room, where 300 km of 0.8 conductor cable were available, on which loaded with inductance coils a value of βl up to about 6.5 was attained, at which figure the volume of sound was extremely low, but the articulation still clear.

With the co-operation of the telegraph authorities experiments were also instituted on lines under actual operating condition, which showed that the attenuation was but slightly affected by the interconnections at the different exchanges.

Though it has been shown that on technical grounds no difficulty can be urged against the laying of long telephone cables, the question has still to be considered in its economical aspect and a complete answer can be furnished only by the operating organizations who have ready at their disposal all the requisite data. However, an approximate idea of this aspect may be gained in cases where the number of circuits to be provided is not too restricted—that is, for interconnection of important towns between which considerable business is carried on. As such towns will, however, be served by a certain number of overhead lines already in existence, it will not be possible to replace them by cables with an actual saving of expense, so that the question can be limited to one of two cases: either the number of circuits is so great that difficulty is experienced in adding any extra lines, or the advantages accruing from the use of underground cables are of sufficient weight to warrant this extra first cost, and of this extra cost being recouped in future years.

The advantages afforded by the cable circuits may be stated as follows:

1. The efficiency of communication once secured is always the same, barring actual faults which, of course, occur very seldom.

2. Cross-talk is effectively eliminated.

3. No interruption is occasioned due to disturbance from external causes.

4. No anxiety is felt as to the cost of repairs due to snowstorms, etc., nor as to interruption of traffic caused thereby.

5. The maintenance of the cables is a much smaller item than that of overhead lines.

6. On laying the cables a certain number of spare wires can easily be provided, which will allow for the easy development of the trunk communications.

7. The reliability and rapidity of communication gains the confidence of the public, and the use of the telephone thereby extended warrants the introduction of such reserve circuits.

8. By the sale of the bronze overhead wires, which at the present time command a high price, the expense can be considerably reduced.

Even putting on one side the reliability and excellence of communication which takes first rank in the appreciation of the public, and also the introduction of spare wires, which would entail some little extra expense, there are still the actual items of reduced maintenance, which in the course of the life of the cable would be considerable. A definite figure on this point is available from the paper communicated by Major O'Meara, engineer-in-chief, of the British Postal Telegraphs, to the congress at Budapest, according to which the maintenance of an overhead wire amounts to 2.9 marks, or, say, 3 marks, per annum per kilometer more than for a wire in an underground cable. While, as regards reserve wires, by adopting, as has been the practice for some time in England, the Dieselhorst-Martin type of cable it should be possible to limit considerably the actual number of reserve wires since 50 per cent of reserve is provided owing to its special construction. In this type the well-known combination of two metallic circuits to form a third metallic circuit is available, the possibility of which in overhead circuits is negatived by the variable and low state of their insulation. The special application of Pupin coils to these extra circuits can also be effected only as they come into use, i.e., as the circuits become fully occupied.

That the cost of the telephone cables will not be inordinately high, the following instance will show. Assume a line

500 km long (about the mean length of important trunks in Germany) and that the route is already supplied by 14 circuits of 4-mm overhead bronze wires, a cable of 28 pairs will be adopted, as it is a certainty that the number of circuits would soon be increased. The cost of such a cable, including the laying and equipping with Pupin coils would be about 10,000 marks per kilometer, or, say, a total of 5,000,000 marks. By the sale of the bronze wires about 2,000,000 marks could be recouped, less the cost of removal, which shows the comparatively high value of the break-up cost of this wire, and thus a total first cost of about 3,000,000 marks would be entailed. The annual saving of cost in the maintenance of this cable would, according to the figure given above, amount to 84,000 marks as compared with an equal number of overhead circuits, which represents a considerable interest on the capital; but if the gain in increase of receipts due to the reliability, security and rapid development of traffic be taken into account, and it be remembered that cables as now constructed are very long lived, and the sinking fund for their renewal correspondingly low, the conclusion may safely be drawn that the laying of important telephone cables is to be advocated on economical grounds.

The length of important trunks in Germany would reach a total of about 4000 km, which for 28-pair cables would represent a total outlay of 50,000,000 marks, reducible to 30,000,000 marks by the sale of the existing bronze wires. But if the decision be taken to place all the important conductors underground, the telegraph lines would also come into this category, and with this in view, there would be no hesitation at the present day to inserting them into the same cables with the telephone wires without any fear of interdisturbance; this is proved by the long lengths of such combination cables now laid in England, though, naturally, if the number of conductors of each class is sufficient separate cables could be laid.

The question has been confined solely to cables loaded on the Pupin system, that is, with inductance added at distributed points, as cables with continuous self-induction are practically ruled out, owing to the lengths required as well as on economical grounds.

As to the efficiency of such cables a clearer view is also now presentable as a consequence of the results above given for their leakage. The writer hopes to return to this subject in the future. At any rate, he thinks to have proved that no hindrance now exists against the placing of cables on all important trunk telephone lines, and thus freeing telephonic communications from all uncertainty and disturbance, which in the towns themselves have already been secured by the networks of underground cables which are everywhere replacing the overhead wires.

WIRELESS DETECTOR.

The sensitiveness of radiotelegraphic receiving stations is known to depend in a high degree on the wave detector. The electrolytic detectors have been introduced with success, and now a new type of instrument based on some as yet insufficiently elucidated phenomena in connection with the contact of certain substances, has been brought forward as a distinct improvement.

In fact, a special advantage of these detectors is that the effects due to individual oscillations are added together, which makes them especially convenient for use in connection with undamped vibrations (for example, in wireless telephony). Furthermore, even the strongest atmospheric discharges are not capable of exerting any destructive effects, and the sensitiveness of the apparatus remains unaltered.

The contact surfaces are made of a number of substances, among which copper pyrite, galena, tellurium and carborundum may be mentioned. According to investigations by Braun, Branley, Tissot and other experimenters, the contact must be made between two different materials. One of the substances forming the contact should be of ore or other material of slight electrical conductivity, whereas the other should preferably be a point of metal or more.

Messrs. E. Ducretet and E. Rogers, of Paris, have designed a detector of this type, shown in Fig. 1. This detector is made up with a number of contact substances which may be interchanged with one another so as to allow the most convenient to be chosen in each case. In fact, owing to the irregular structure of ores and their lack of homogeneousness the various portions of a given specimen are far from being of the same sensitiveness so that the whole surface of the substance should be tested.

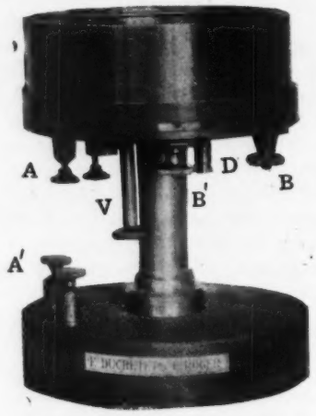


Fig. 1—Wireless Detector.

The substance *M* to be tested (Fig. 2) is fixed in the center of the case with four set-screws on a substantial metal plate free to oscillate round a point close to the wall, which allows the substance to be displaced laterally by means of the knob *B'*. The center around which the plate is rotating is fixed, in its turn, on another movable plate free to oscillate about another pivot so that the former, and therewith the substance *M*, may be imparted a motion at right angles to the former displacement by means of the knob *B*. Above the substance *M* is located a point fixed by means of a screw to the end of a very flexible spring. This point is so mounted as to be readily interchanged. A second point *P'*, which is likewise carried by a spring, may be used if desired (for example, for increasing the effects of materials of very low conductivity) with a view to assist the

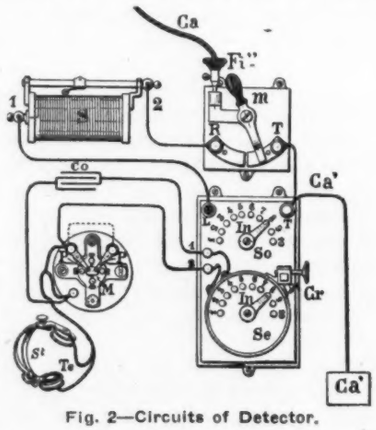


Fig. 2—Circuits of Detector.

former. By turning the spring round its axis the point *B* can likewise be displaced somewhat in a lateral direction.

The contact pressure between the substance fixed in the center and the movable point is controlled by a screw *V* with long stem terminating in a knob.

The point can, accordingly, be carried successively all over the surface of substance *M*. As soon as the most sensitive point has been found out, the movable plate is fixed in position by means of the set-screws *B B'*.

The whole apparatus is mounted in a copper housing on a column with heavy foot, and is locked by a lid and glass page. The housing is impervious to any dust and moisture. All the operations required for regulation are made outside of the apparatus proper. The tube *D* can be used if required for establishing a connection with a drying flask, or for introducing different kinds of gas into the interior of the apparatus.

MAGNETIC PROPERTIES OF MATERIALS.

By CHARLES P. STEINMETZ.

When some years ago Heussler discovered a magnetic alloy of three unmagnetic materials, considerable speculations were made, and are still occasionally indulged in, as to the bearing of this alloy on the nature of magnetism; and the conclusion has been suggested that ferro-magnetism is not a property of a group of elements, as was frequently assumed before, but the result of certain molecular or crystal structure. Unfortunately, the foundation on which these speculations were based are erroneous, as the Heussler alloy is not an alloy of unmagnetic materials, but an alloy of the magnetic metal manganese. In other words, manganese is a strongly ferro-magnetic metal. So far as I know, pure manganese has never been observed in the magnetic state, but many of the manganese alloys are ferro-magnetic or can be made so by heat treatment.

The most easily prepared magnetic alloy of manganese is the manganese antimony, which was brought to my attention by Dr. Hardén soon after the discovery of the Heussler alloy, which does not even require furnace facilities for its preparation. About one part of manganese and three parts of antimony are broken up to a coarse powder, mixed and heated to a moderate temperature, for instance in a test tube in the bunsen flame; the alloy becomes a black powder, which is strongly magnetic, and can be used like iron filings in indicating the lines of force of a magnet.

By dissolving metallic manganese in melted antimony, zinc, tin or other metals, strongly magnetic alloys frequently result and can be cast into various forms; and in any collection of manganese alloys some usually are found more or less strongly magnetic. The addition of a small percentage of sodium or aluminum facilitates the production of these alloys, by protecting the manganese from oxidization by a reducing action. In the Heussler alloy, the aluminum possibly plays a similar part. No magnetic alloy, however, has ever been found which does not contain some of the metals iron, cobalt, nickel, manganese or chromium.

These magnetic manganese alloys have the same curious property as the iron alloys, in that their permeability depends enormously on the heat treatment. In steels, the permeability at medium magnetic densities can be increased or decreased many fold by annealing or chilling, though at its lowest value it is still so high as to show strong ferro-magnetism. With iron alloys, however, which are of lower permeability, as some of the iron-nickel-chromium-manganese alloys which recently have been introduced as resistance wires, the lower value of permeability is so low that these materials can almost be said to have a magnetic and an unmagnetic state. Some nickel steels are known that by heat treatment may be brought into a strongly magnetic, or into an almost unmagnetic state; and the alloy of iron with a moderate percentage of manganese in its virgin state sometimes shows a permeability of less than 2, while under treatment its permeability rises to equality with a poor grade of steel. (Ewing.)

The Heussler alloy when carefully annealed is almost non-magnetic, but by suddenly cooling it from incandescent temperature, and especially by dropping it melted into cold water, it becomes strongly ferro-magnetic. Similar dependence of the permeability on the heat treatment exists in other manganese alloys, and manganese-zinc, manganese-tin, etc., may be practically non-magnetic, or may be of a fairly high permeability.

Looking at the position of the magnetic metals in the periodic system, they are found to form a group of adjacent elements, with iron in the center, and on the side toward higher atomic weights, cobalt and nickel, and toward lower atomic weights, manganese and chromium.

As the latter metal, chromium, shows some ferro-magnetic properties, its investigation would be interesting. There is known an intermediate oxide of chromium, not far different structurally from the iron oxide magnetite, which is fairly strongly magnetic, but has never been carefully investigated, as far as I know; and it is quite possible that among the alloys of chromium with non-magnetic metals some may be found under certain conditions markedly magnetic.

Manganese also seems to have a lower oxide that is strongly magnetic, comparable if not superior in permeability to magnetite. The black reaction product of antimony and manganese seems to consist partly of this oxide, since its magnetic permeability is higher than that of cast manganese-antimony.

A PHYSIOLOGICAL EFFECT OF AN ALTERNATING MAGNETIC FILE.

In a paper presented April 14 before the Royal Society, Prof. S. P. Thompson gave the result of some experiments showing that an alternating magnetic field may produce a physiological effect. Down to the present time it has been held by all physicists and by all physiologists that magnetism produces no physiological effect, either on the human subject or on any living organism. Many persons have looked for such effects. Lord Lindsay (now the Earl of Crawford), assisted by Mr. Cromwell F. Varley, constructed many years ago an enormous electromagnet, now in the Observatory at Edinburgh, so large that it would admit between its poles the head of any person who wished to test whether a strong magnetic field would have any sensible effect. Nothing whatever was perceived as the result.

Professor Thompson, however, recently succeeded in demonstrating a real physiological effect due to magnetism. Some six years ago, when experimenting with an alternating electromagnet which had been constructed for showing Prof. Elihu Thomson's well-known experiments on the repulsion of copper rings, he observed a faint visual effect when his forehead was placed close to the magnet. Recently, incited thereto by finding Lord Kelvin's mention of the negative results in Lord Crawford's experiments, he further explored the matter, and found a means of producing the visual effect (which is subjective and physiological) in a way that succeeds with every person on whom it has yet been tried.

An alternating magnetic field of sufficient intensity and extent was produced by passing an alternating electric current around a specially constructed magnetizing coil. This coil, consisting of 32 turns of stranded copper wire, having an equivalent cross-section of about 0.2 sq. in. in each turn, was wound upon a wooden cylinder about 9 in. in diameter, and about 8 in. long; the cylinder being then removed. The alternating current, of a frequency of 50 periods per second, could be increased up to 180 amp at will; so that the total number of ampere-turns of the coil reached 5760. The intensity of the alternating magnetic field at the center of the coil had therefore a virtual value (quadratic mean) of about 1000 c.g.s. units; and its instantaneous maximum value (at the center of the coil) was therefore about 1400 c.g.s. units. The value at the mouth of the coil was not much more than two-thirds of this amount, and was not uniform over the cross-section of the interior space.

On inserting the head into the interior of the coil in the dark, or with the eyes closed, there is perceived over the whole region of vision a faint flickering illumination, colorless or of a slightly bluish tint. The period of the flicker is not well defined. It does not seem to be the same over the whole region of vision at the same time, nor is it equally bright over the whole region of vision, but is somewhat brighter in the peripheral region than in the central parts. Even in daylight, with the eyes open, one is conscious of a sensation of flicker superposed upon the ordinary vision.

The effect is diminished by lowering the intensity of the field, and increased by raising it. Attempts to discover whether the brightness of the phenomenon stands in any relation to the direction of the axis of the field with respect to the directions of the principal axis of the scull have not yet revealed any definite result. It will be necessary to apply more intense fields than have yet been tried. No after-effects of any kind have been experienced, either by Professor Thompson or by any of the persons who have made the experiments with him.

As yet it has not been possible to ascertain whether varying the frequency has any effect on the phenomenon.

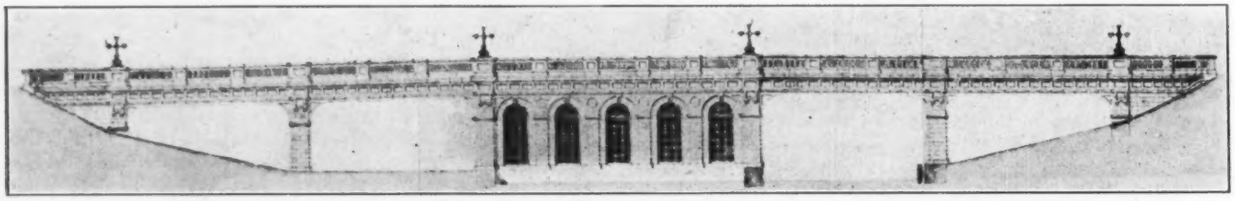
The phenomenon is so distinct when once it has been seen that it is difficult to believe that it has not been observed before by those who have been working with transformers. Nearly four years ago Professor Birkeland, of Christiania, told Professor Thompson that his workmen at the nitrate factory at Notodden declared they could see lights over the choking coils used to limit the currents supplied to the electric furnaces. This may have been in reality a subjective phenomenon, similar to that now recorded.

No effect upon the senses of smell or hearing has yet been observed; but an effect on the sense of taste has been noted.

ELECTRIC PUMPING STATION UNDER ORNAMENTAL BRIDGE.

Near the place where the new North Shore Channel of the Chicago Drainage Canal will connect with Lake Michigan at Wilmette, Ill., a rather unusual disposition will be made of the electric pumping station to be erected at that point. It is necessary to lift the water 3 ft., and this will be accomplished by four Allis-Chalmers screw pumps each having power to lift 250 cu. ft. of water a second. These pumps will be driven by four 150-hp electric motors, probably of the alternating-current type made by the General Electric Company. Electrical energy will be obtained, no doubt, from the hydroelectric plant of the Sanitary District on the main channel of the Drainage Canal at Lockport, Ill.

As shown by the accompanying illustration, the Wilmette pumping station will be placed under the ornamental Sheridan Road bridge, of which it will form a part. Sheridan Road, running parallel with the lake shore, crosses the channel about 400 ft. west of the inlet. The bridge is of steel construction faced with cut Bedford stone, with concrete roadway and sidewalks and cut-stone railings. It is to be in six spans, the two center spans enclosing the pumping station, which is to be faced with cut stone also. A lock 32 ft. wide will be built under the bridge, adjoining the pumping station building on the south. The bridge will be 215 ft. long, with 46-ft. driveway and two 8-ft. sidewalks. The entire cost of the bridge, pumping station, lock and retaining walls on the sides of the channel between the lake and the pumping station will be about $165,000, and the pumping machinery will cost $75,000 additional. It is expected that the North Shore Channel will be completed during the present year.



Pumping Station Under Bridge.

PRODUCER GAS PLANTS.

Mr. William H. Spiller, of Kansas City, gave a talk before the Iowa Electrical Association convention, at Sioux City, April 20, on producer-gas plants. Commercial investigations on this subject, he said, reached back to 1890. Some of the first commercial plants were installed in 1903 and 1904 at the World's Fair, at St. Louis. In 1909 over 50,000 hp in producer-gas engine plants were in use in America. It was found frequently that producers which were successful on European fuel would not work well on American fuel in all cases, and the producers had to be redesigned for American fuels. There were also difficulties in getting a sales force which understood producer-gas plants, and which could intelligently sell them. Producer-gas manufacturers also had to contend with the ridicule of their claims for high fuel efficiency, because of the great difference between the claims made for the producer-gas plant and the actual consumption of steam-engine plants. Another difficulty which the manufacturers had to overcome was that of getting competent gas-engine operators who understood producers and gas engines. Since 1900 some 20 American makers of gas-producer power plants have come into the field.

The first cost of the gas engine and producer was also against it at the start, as compared with the steam plant. The cost of a gas engine and producer plant is now from $40 to $70 per horse-power. He told of the case of a man who said that the low fuel consumption claim for a producer-gas plant was absolutely impossible, his ideas being based on his knowledge of the performance of steam-engine plants. This man was finally induced to go to a gas-engine producer plant and personally make a test lasting several days on the amount of fuel used by the engine and the output. He was then thoroughly convinced.

In the suction-type producers, where the draft is produced by the suction of the gas engine, anthracite, coke or charcoal is used. In the bituminous producers forced draft is usually applied. He referred to Bulletin 416 of the United States Geological Survey (abstracts from which have appeared in these columns) as giving much valuable information about gas-producer plants. Manufacturers now guarantee coal consumption of not over 1.25 lb. to 1.5 lb. per hp-hour. The water required in the scrubber runs from 2 gal. to 3.5 gal. per hp-hour, and in the jacket from 4 gal. to 6 gal. per hp-hour. In some plants the fuel cost has been brought as low as 0.78 lb. per hp-hour.

Central Station

Management, Policies and Commercial Methods

WHEN CUSTOMERS KICK.

A progressive Southern electric light company has one of its office employes scan all the local newspapers for notes and reports of parties, receptions, dances, etc., given by people who are customers on its lines. These items are carefully clipped and filed in a scrapbook, for office reference. Then when a complaining customer appears in the company's office and avers that the increase in his lighting bill is totally unaccounted for, as no excess energy, he says, has been used during the month it covers, the office employe is frequently able to turn to the scrapbook and remind the customer that he had an entertainment at such a date, which is probably responsible for the additional consumption. This explanation usually pacifies the customer and is of service frequently enough to make the slight trouble involved well worth while.

The same scrutiny of the social columns might also be used, as has been noted here before, to get the "dates-ahead" of affairs

for which the company would loan heating and cooking appliances, thus aiding in popularizing and introducing these devices.

CATCHING THE CONSUMER YOUNG.

The new-business department of the Little Rock Railway & Electric Company, Little Rock, Ark., copies from the column of vital statistics in the local newspapers the names of all the happy households, connected to its service, in which a birth occurs. A few days later an electric milk-warmer, possibly a disk stove, or some other heating device, are delivered to the house, on loan. These devices usually prove so acceptable at the time that but very few are returned.

A WIRELESS WINDOW DISPLAY.

The Citizens' Light & Traction Company, of Pine Bluff, Ark., has in its offices an apparently "wireless" window display that arouses considerable conjecture among those passersby who know that enough electrical energy to light a 16-cp lamp cannot be very well transmitted over the surfaces of the large slab of plate glass which is the sole support of the merrily winking lamp.

The plate-glass slab, about 30 in. high and 12 in. wide, is held vertically by wooden foot-pieces resting on a pile of books in the bunting-covered window. On the top edge of the glass is perched a small wooden cleat just large enough to support the socket carrying the lamp, which is being continually lighted and extinguished. Two short pig-tails of lamp cord, with frayed ends, which protrude from the socket, furnish the only clue to students of high-frequency phenomena as to just how the supply of energy to the lamp might be accomplished. The real working conductors, however, are a pair of No. 36 wires brought up along one edge of the plate glass, and cleverly concealed under an edging of green passepartout paper which is quite unnoticeable, as it simulates closely the reflection of the glass edge. The display was originated by the line foreman of the company.

A LIBRARY INDEX IS USEFUL.

A progressive central-station manager in a town of 13,000 inhabitants, in the Southwest, finds a special index to his library of bound technical journals and books to be one of the best investments for the small amount of time and money necessary to keep it up properly. As the journals are received they are read through carefully for items of special interest bearing on local problems and situations, and a note of the title, periodical and page, or date, is entered under the subject, in alphabetical order, in a loose-leaf index book. Special formulas, data and other items of personal interest can be entered in the same way. The journals themselves are then bound, with their publishers' general index pages, of course, and the volumes placed on the library shelves for ready reference.

After this system has been carefully followed out for a short time, it is found that a surprising amount of pertinent and valuable data is made available for immediate reference, without the trouble of consulting several general indexes. The information received is valuable, not only for reference on matters of engineering and operation, but is often found useful in demonstrating some point or closing an argument.

Thus if a customer enters the office and wrathfully avers that not only his watt-hour meter, but the whole tribe and genus of electricity meters are specially constructed by a group of speed-mania experts to run wild with the governor jammed, the manager calmly looks in his index under "Meter tests," turns to the page reporting a series of official State tests, and shows the consumer what a small per cent of meters were actually found to register fast or in error on that occasion. No time is thus lost in looking for the subject or date of a half-recollected article. The library index thus justifies itself in many ways, and the time necessary to keep it abreast of the large amount of useful material appearing in the technical journals is a small part of that saved when an important reference is to be found in a hurry.

ELECTRICAL FEATURES OF OMAHA'S TALLEST OFFICE BUILDING.

The new City National Bank Building at Sixteenth and Harney Streets, Omaha, now nearing completion, will be the tallest office building in that city. The Omaha Electric Light & Power Company will supply the electricity needed for lighting and the operation of motors in this building. About 6000 16-cp carbon lamps will be required, but the fixtures are arranged so that tungsten lamps may be substituted later if desired. A Crouse-Hinds meter panel is installed on each floor, and so arranged that by simple manipulation the metering can be adapted to any division of the space on that floor by use of one meter panel. Another interesting feature of the electrical construction is the use of a special type of bracket fixture with an additional socket to which may be attached a connection for a desk light, thereby saving the use of a base-board plug or a two-arm bracket. This bracket was designed by Mr. F. H. Getchell, of Chicago, and is figured to effect a saving of $5 a room where an additional outlet for desk lighting is desired. There are four Otis worm-gear traction electric elevators in the 16-story building and in addition about 250 hp in motors used to drive pumps, ejectors, ventilating fans, etc. The lamps are wired single-phase, the small motors three-phase, and the elevator motors on 500-volt, direct-current circuits. Holabird & Roche, of Chicago, are the architects.

ELECTRICITY FOR THE GAS COMPANY'S BUILDINGS IN CHICAGO.

At the corner of Michigan Avenue and Adams Street the People's Gas Light & Coke Company is erecting one of the largest and handsomest office buildings in Chicago. The edifice is 20 stories high, with an attic, and covers a ground area of 33,810 sq. ft., with a floor area of 700,000 sq. ft. The first two stories are of granite, with imposing polished columns of the same material, and the facing of the upper stories is of gray terra cotta, matching the granite. While this building will contain the offices of the gas company, the greater part of it will be rented to tenants.

Both electricity and gas will be available for lighting. The Commonwealth Edison Company will furnish the electrical energy, and the building is being wired for about 18,500 16-cp. incandescent electric lamps and 1400 hp in electric motors for elevators and other purposes. There will be 15 electric elevators, consisting of 14 passenger elevators and one freight elevator. These elevators will be of the recent one-to-one traction type made by the Otis Elevator Company. In addition, there will be motors to drive ventilating fans, blowers, house pumps, coal conveyors, centrifugal pumps, vacuum pumps, etc. Such a large amount of electricity will be required for the general purposes of this building that the contract for supplying it is based on the central-station company's regular wholesale schedule for light and power. This schedule applies only to large users of electricity, and in ordinary cases office buildings do not fall within the rates which it provides.

Tenants will have the option of using electricity or gas, or both, for lighting. The gas company itself will use gas for lighting its offices and salesrooms, as may be imagined. A portion of the building is now occupied, and temporary gas fixtures are in place. Ultimately, however, all fixtures in tenants' rooms will be combination fixtures, so arranged that the gas lighting will be indirect and the electric lighting direct. Mantels will be attached to the gas burners, of course, and it is probably the

theory of the gas company that the indirect gas lighting will be pleasing to tenants and more economical than the electric light. The actual results of the experiment—that is, the proportion of tenants using the gas and electric light, respectively—will be of interest when the building is fully occupied and sufficient time has elapsed to enable the tenants to make an intelligent choice.

It is said that the building will cost about $4,000,000. The architects are D. H. Burnham & Company, and the electrical contractor is Mr. A. S. Schulman.

TACTFUL RELATIONS WITH CUSTOMERS.

"How to Meet and Deal with Customers" was the subject of Mr. John W. Ferguson, assistant to the general contract agent of the Commonwealth Edison Company, who addressed the Electric Club of Chicago at the regular weekly meeting of May 4. Mr. Ferguson said that this subject has attracted a great deal of attention during recent years, and it is difficult to over-estimate its importance. Its importance has to do not only with the present generation, but in training up those who shall conduct business in the future. In 1893 the subject was taken up by the National Electric Light Association, and the present commercial-day sessions of that association may be perhaps considered an outgrowth of that movement.

It is necessary not only to generate and transmit electricity, but to satisfy the people who receive it. These persons are reached by personal interviews, telephone calls and letter-writing. Personal interviews, where tone, gesture and facial expression have much to do in modifying the spoken words, are generally pleasing, but especial attention should be given to letters and telephone messages. A most important duty of the business man of to-day in dealing with the public is to watch the communications over the telephone made by subordinates. The telephone companies themselves are training their employes in courtesy, and the users of the telephone should do likewise. In large business houses, heads of departments should carefully train the younger employes in relation to courtesy of speech and consideration for others.

Letter-writing is also important. If caustic letters are received, they should not be answered in the same vein; do not retaliate in kind. The writer of the letter has some grievance, real or imaginary; he should be conciliated, or he will become still more angry, and very likely take his business somewhere else.

Being tactful is in itself a pleasure, and it is a virtue that should be studied and encouraged through all the departments of a company. It is the good office boy who becomes the good clerk, and successively district manager, general manager and president. It is the good president who is at the command of the public. Trouble is generally caused in dealing with the public by under-employes who do not realize their importance to the company or else possibly by some heads of departments who realize their importance too much. The department head should surround himself with courteous and tactful people—employes who can in effect "carry the message to Garcia."

Mr. Ferguson closed his instructive talk by a reference to the tact that may be shown by the men engaged in various departments of the central-station company. In the repair department, for instance, there is a great demand on employes to exhibit diplomacy. Questions may be put to these men that they should not answer, and they should study how not to answer and still avoid giving offense. Many repair men exhibit a great degree of diplomacy in meeting this situation. The cut-off department also affords an opportunity for diplomacy. The speaker instanced one man who was detailed to cut off customers for non-payment of bills, and in very many cases this man came back with the money due and the assurance that the company was retaining a satisfied customer. This accomplishment requires a conspicuous degree of tact and conciliation. The inspection department and the contract department were also mentioned as affording unusual opportunity for establishing pleasant relations with customers.

Remarking that men in practically all walks of life are salesmen, with something to sell, President F. P. Vose opened the discussion by recounting some early instances in his career. Mr. P. R. Boole remarked that all are buyers as well as sellers, and all sellers should practice what they preach when approached by other sellers. Salesmen will do well to remember in entering a business house to sell goods that that house is itself a selling organization, and that the purchasing agent is a part of a selling organization. Others taking part in the discussion were Messrs. J. H. Delaney, F. L. Perry, C. A. S. Howlett and W. S. Taussig.

SELECTING A WATT-HOUR METER.

The selection of watt-hour meters by competitive tests is the subject of a bulletin issued by a prominent German firm and although intended for German conditions, it is believed that the abstract given herewith will be of value to American central station men.

The question of selecting the most suitable type of meter for installation among the consumers is one that usually some time confronts every central station manager. There being a great many different makes on the market and a variety of service conditions to be provided for, a proper selection is not an easy task. Besides, if the question of cost must enter the problem, the number of meters which can come under consideration may be restricted, but the necessity for great care is

Fig. 1—Application of Torque Balance.

increased. Meters which are so inaccurate and unreliable in operation as to be dear at any price must be weeded out, not only to protect the interests of the central station and the consumers, but to discourage the continued manufacture of such inferior apparatus, thereby benefiting indirectly the whole electrical industry and the public at large.

To make an intelligent selection from the various meter types which may be submitted for competition, and about which the central-station manager may have no adequate previous information, it is necessary to have an equitable, common basis of comparison. The program for comparative tests of meters, as at present pursued by most central stations in Germany, is practically as follows: A number of sample meters submitted by the competing manufacturers are connected in series with a suitable load, and an indicating wattmeter is included in the circuit. To pass this test a meter must register the same amount of energy as is arrived at by calculation on the basis of wattmeter readings. Another test is made to determine light-load and no-load characteristics. For this purpose the meter is connected to a minimum load, which usually

consists of a 5-hefner incandescent lamp. If the meter starts promptly at this load, and does not creep at no-load, with normal or somewhat over normal voltage, it is considered satisfactory in these respects.

The shortcomings of the above tests can easily be shown. In the first place, the temptation to submit for competition samples which have been specially prepared, may prove too strong, even for manufacturers of undoubted honesty. The conditions of the tests are well known to the competing firms. It, therefore, would be almost too much to expect that a manufacturer should send for competition a sample which he had not previously ascertained would satisfy these conditions as fully as possible, if only to be on an equal footing in that respect with his competitors who might be expected to do the same thing.

In the second place, the requirements of the test are such that no meter which is any use at all to put on the market can fail to pass fairly well when the sample is new and has perhaps had the advantages of especial attention. On the other hand, even the best of meters may have become slightly damaged in transportation, so as to make a poorer showing than it would have made if in perfect condition when tested. Of course, susceptibility of that nature is a bad feature, but the tests in question are not made to determine superiority in that respect; nor do they provide for taking into account such purely accidental imperfection of a sample meter, in the comparison of results.

To arrive at a true estimate of the comparative values of various meter types an entirely different method of procedure must be followed. Instead of samples especially submitted for the purpose, meters which have been in actual service at least a year should be tested. It is a well known fact that all the external influences which progressively affect the accuracy of a meter act in the same sense, namely, to retard it. No meter of whatever construction is entirely immune against their action. At the same time the degree to which the different types may be affected thereby varies considerably. While some makes show hardly any impairment of quality after a year of service, others, after such a period, will have become so inaccurate that no central station manager would knowing-

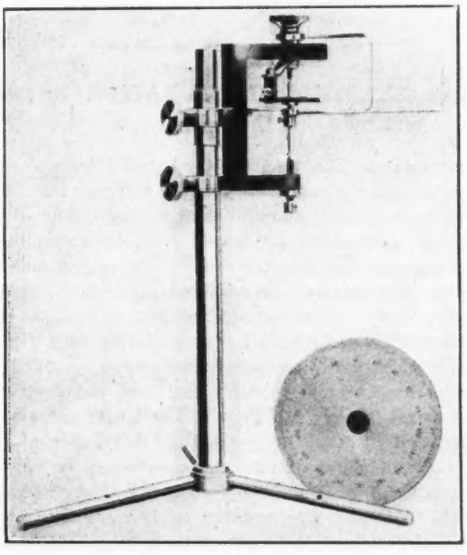


Fig. 2—Device for Determination of Torque.

ly consider their adoption, at any price. The great majority of meters employed nowadays belong to the so-called motor class. Just like any other motor these meter motors have a definite torque. The forces involved, however, are very small and require special instruments for their measurement.

A spring dynamometer, designed for this purpose, and the manner of its application, is shown in Fig. 1. In view of the importance of the measurements obtained by means of this instrument, for judging the quality of a meter, some details as to its construction and use may not be amiss.

In order to determine the torque of a meter, a small clamp with a pin projection is attached to the armature disk in such a way that the pin coincides with the periphery thereof. The instrument, with the long lever and torsion pointer at zero mark on index plate, is then placed opposite the meter to be tested so that the center of armature disk, clamp pin, lever, pointer and

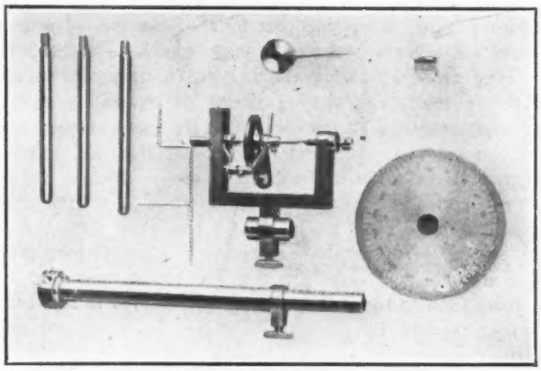


Fig. 3—Exploded View of Torque Balance.

center of index plate lie in a straight line. After the apparatus has been thus set up the meter is connected to a load equal to its maximum capacity and the tip of the lever is laid against that side of the clamp pin toward which the armature disk tends to move. To maintain the lever at the zero mark it now will be necessary to turn the knob a certain number of degrees, which directly or by means of a constant gives a measure in grams of the spring tension applied. Multiplying this value by the radius of the armature disk, in centimeters, the torque of the meter is obtained in centimeter-grams.

Values obtained in this manner may be as low as 0.2 or as high as 12 cm-g, according to construction and condition of the meter. But the absolute values cannot be used directly as a basis for comparison. The weight in grams of the moving element and its angular velocity in revolutions per second at maximum load must be included. Thus

$$\frac{Torque}{Weight \times Angular\ Velocity} = Life\ Factor$$

By means of this life factor a very reliable estimate can be made as to the relative values of different meters in regard to useful life, even though the actual number of years of such life may be impossible of exact prediction by calculation. It may be of interest to note that the life factors of the best German makes are, for direct current meters 0.050 to 0.070, for single-phase meters 0.130 to 0.260, and for three-phase meters 0.130 to 0.200.

Since most, if not all meters are provided with means for artificial braking or "damping," the magnitude of this should be ascertained. This may be done by bringing the meter to full speed at maximum load and then suddenly disconnecting the meter from the line. The number of revolutions which the armature will continue to run by virtue of its momentum is an inverse measure of the braking effect. The lower this number the better the damping. A little consideration will make it evident that, other things being equal, the greater this damping in proportion to the aggregate of the other retarding forces the more constant will be the accuracy of a meter. By providing in the original design a sufficiently high value for the damping, the effect of the gradual increase, in the course of time, of the other retarding forces will be minimized and may be made negligible.

It is, of course, assumed in the foregoing that the damping magnets will remain permanent throughout the life of a meter. The effect of all the influences which may affect the per-

manence of magnets may be simulated, in an intensified degree, by a powerful short-circuit immediately behind the meter. Really permanent magnets will not suffer appreciably from this, while others may weaken to such an extent as to cause the meter to run considerably faster and longer if the above damping test be repeated. A comparison in this respect should be made also.

Of all the deteriorating influences to which a meter is subjected while in service, that of friction and consequent wear is one which cannot be entirely eliminated or made absolutely constant. It is conceivable that by the greatest refinement in construction other sources of change may be prevented for a long time from impairing the original accuracy of a meter. But the mutually aggravating effects of natural friction and wear of bearings, and (in direct-current meters) commutator parts, can only be minimized. If no special consideration has been given to this point in the design, a meter which in the initial stage of service is sensitive enough to start at minimum loads may fail to do so after the lapse of a few years. On the other hand, in a meter of suitable construction, a satisfactory starting torque may be maintained practically constant by proper attention from time to time. Superiority of features in this respect, therefore, should be given due weight in a comparison of meters.

In regard to the bearings the essential points are an inherently low friction and facility for renewals of worn parts. While this refers more especially to the lower bearing, examples are not lacking where the upper pivot even when made of the best grade of steel has become roughened through wear so as to affect seriously the sensitiveness and accuracy of the meter. Pivots that are long in proportion to their diameter have proved very satisfactory in this respect. Besides, such pivots, on account of their length, are less liable to break, and, in the case of alternating current meters, will adapt themselves to the effects of the current reversals. It is evident that the lower pivot, which has to support the weight of the moving element, is particularly subject to wear, and provision for its ready replacement is an important feature of a meter.

In the commutator type of meter there are two factors which exert a variable influence on the starting torque. One is the friction between brushes and commutator surface. The other is the sparking, with consequent oxidation and scarring. To minimize both, the diameter of the commutator should be small and the brush pressure firm but elastic; also, the difference of potential between adjacent segments should be low. To balance the various more or less conflicting considerations so as to obtain the best total result, requires the nicest care of the designer.

While in the foregoing great stress has been laid upon a high starting torque for light loads, the sensitiveness of the meter must under no considerations be such as to make it liable to "creeping" at no-loads. To ensure against this there should be provided a device which will make starting at no-load positively impossible. This device should be so adjusted that it will take care of a temporary rise in the line voltage. It probably is sufficient to assume a 10 per cent increase over the normal as a safe upper limit. When testing the sample meters these, therefore, should have such a maximum voltage applied to the shunt coils alone. To pass this test a meter must then not start even when subjected to intentional vibration.

Finally, in judging the relative merits of different meters the question of repairs should be considered. Generally speaking there are two classes of repairs which may be necessary. One is the renewal of parts due to normal wear and tear. To the other belong repairs made necessary by external influences such as climate, weather, chemical action of surroundings, accidental injuries, etc. All parts should be accessible and those subject to wear should be easy to replace. Since all repairs cannot be made on the premises the parts should be logically arranged and easy of inspection, so that the inspector may be able to locate definitely any defect, and to decide whether, on the whole, the central station has the necessary facilities, before an attempt is made to repair. The adjustments and the interchangeability of supply parts should be such that a meter which has been repaired can be restored, at least approximately, to its former normal characteristics by means of a simple after-calibration.

In the early state of the art the designers, as a rule, gave little heed to facility for making repairs but felt content if they had achieved a form of construction which would satisfy all reasonable requirements of operation. Meters of that obsolete character are still on the market. While such meters may be fairly satisfactory in other respects, they generally are impossible to repair without being taken apart. Thus, of two meters which are found to be in all other respects equally good, that which offers the greater advantages for proper up-keep evidently is the better apparatus.

Wiring and Illumination

EXTREME LIFE OF TUNGSTEN LAMP.

A 250-watt tungsten lamp in the bakery of the Arlington Hotel, Hot Springs, Ark., on April 11 closed its unusual career after having burned continuously, 24 hours a day, since Oct. 7, 1908, thus rounding out the extraordinary life of over 13,000 hours. On one of the three known occasions when the lamp was extinguished it was turned out for the inspection of the members of the Arkansas Public Utility Operators convention in session at the hotel, and although its long life at that time occasioned much interest, it continued burning 11½ months more, finally having its filament separated by an accident to the nearby 8-hp steam engine driving a dish-washing machine. This engine was mounted but 6 ft. away from the lamp, and was operated a number of hours each day during the life of the lamp. On the date mentioned, the belt came off the engine and the latter ran away. When the excitement had subsided the lamp was found to be extinguished.

SPECIAL ELECTRIC ILLUMINATION AT SALEM, MASS.

In connection with a special "Merchants' Carnival" at Salem, Mass., the Salem Electric Lighting Company installed about 2300 8-cp incandescent lamps in the business center of the city, the lamps in general being hung in festoons across the streets with shields, stars and crosses at intervals adding materially to the display. At the junction of Washington and Essex streets flaming-arc lamps were installed at the corners, so that the effect of the electrical decorations could be seen from every angle of approach. Illuminated signs were installed bearing the designation "Merchants' Carnival," and the electric shields bore the words "Trade in Salem." The larger signs were provided with letters 15 in. in height, there being five of these installed in the outskirts of the city to welcome the people from out of town. A considerable number of colored lamps were also used. Although the occasion is in a measure an annual affair, the decorations this year were more extensive than before, and the value of electric lighting has been more thoroughly impressed upon the public. An informal meeting of the local managers of a number of the Tenney companies, of which the Salem is one, was held at Salem during the carnival week. The company has lately published a Salem guide book, giving street-car schedules and other useful information and pointing out the value of central-station service. Mr. S. Fred Smith, past-president of the New England Section of the National Electric Light Association, is local manager of the company.

ELECTRICAL EQUIPMENT OF HOTEL SHERMAN, CHICAGO.

The latest of the trio of fine modern hotels to be built in Chicago is the Hotel Sherman, superseding, on the same site, the old Sherman House at Clark and Randolph Streets. The new hotel, which is now in process of erection and is expected to be ready for occupancy about the first of next year, is a handsome 16-story building with 624 guest rooms. Electrically considered, it is interesting because, unlike the two other new hotels, the La Salle and the Blackstone, which have private plants, it is supplied with electrical energy by the Commonwealth Edison Company. Further, tungsten lamps are used very largely for lighting. The building has about 15,000 incandescent lamps, and about 80 per cent of these will be tungstens, in 40-watt, 60-watt and 80-watt sizes.

While it is not positively decided, it is probable that the lighting in the guest rooms will be on the indirect system. In the restaurants, banquet-rooms, ballrooms and other special rooms, there will be a number of beautiful fixtures. Many of these are of crystal, and all were made after special designs prepared by the architects of the building, Holabird & Roche.

Electric motors having a total rating of about 550 hp and numbering about 50 will be installed in the building. All are of the 220-volt, direct-current type. The elevators are all electric and are of the Otis worm-gear traction type. There are four passenger and three freight elevators, as well as three Burdett-Rowntree electric dummy waiters rising the whole height of the building. Motors are also used to drive ventilating fans, ice machinery, pneumatic tubes, a silver polisher, potato-peeler, dish-washer, meat-choppers, the laundry machinery, etc. Electric flatirons are used in the laundry. The consumption of electricity is large enough to bring the building on the wholesale schedule of the central-station company.

The telephone switchboard is equipped for four positions and 800 lines. It is of special mahogany finish, and a telautograph set is placed flush with the bench portion of the board, beside each operator's position. The telautograph equipment connects the information clerk, room clerks, manager's office, carpenter shop, engineer's office, order checkers, and some of the other departments of the hotel. All telephone wiring, as well as the light and power wiring, is placed in Sheraduct conduit.

The Cuthbert Electrical Manufacturing Company is contractor for the electrical construction, and Habirshaw Red-Core wire and Hart switches are used. The motor contract has not been let.

The steam-heating plant will be operated at high pressure, and a connection will undoubtedly be made with the Illinois Tunnel Company's system for the underground delivery of fuel and removal of ashes.

CALCULATION OF ILLUMINATION BY THE POINT-BY-POINT METHOD.

BY ALFRED A. WOHLAUER.

The determination of the horizontal illumination by the well-known point-by-point method, which is one of the most common problems in illuminating engineering, involves considerable difficulties not admitting of a simple and quick solution. The reason for this lies in the fact that on account of the various angles entering into the calculation, the simplest formula for practical use contains a trigonometric expression involving usually the cube of the cosine of an angle. Efforts have frequently been made to overcome this obstacle and adapt the method to the engineer of limited mathematical training, and for this purpose tables, charts and the like have been introduced to obviate the necessity of laborious computations. No one, however, has succeeded thus far in eliminating all of the inconveniences and presenting a general equation which is practical and suitable for every case.

In the issue of the *Electrical World* for March 24, Mr. Albert F. Parks widens the field of the calculations to include the problem of inclined light sources, thereby suggesting a method which is rather interesting. Inasmuch, however, as the solution requires the use of a special chart, thus increasing the number of working tools of the illuminating engineer, the present writer has examined the problem again to ascertain whether it could be solved in a simpler way, since the use of the flux-of-light method has not yet become popular. He has succeeded so far as to require for the calculation only the polar co-ordinate paper commonly used, and in finding a simple equation which answers the above purpose.

The equation has the well-known form

$$\lambda = \frac{U}{h^2 + r^2}$$

where λ = the horizontal illumination in ft-candles,
h = the height of suspension,
$r = d$ the distance from the foot of the light source,
U = the vertical projection of the light intensity in the direction of the point under consideration.

U is to be measured by the usual candle scale, while h and d are to be expressed in feet.

This equation is correct in every case for which the polar candle-power curve of the illuminant is known, whether the latter is suspended vertically or inclined, and whether the point under consideration is underneath the lamp in the same or any other plane. In order to demonstrate this fact it is well to discuss, with reference to concrete examples, the various cases that may come under consideration.

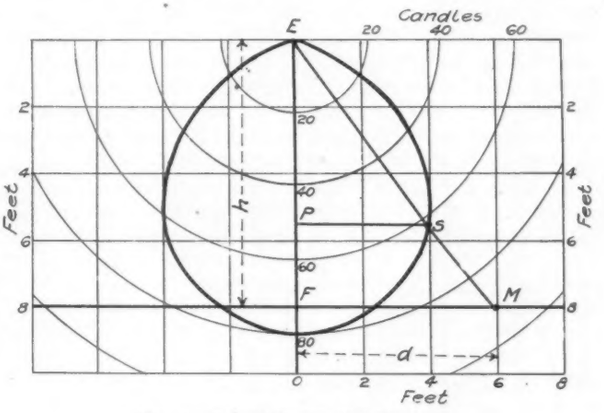


Fig. 1.—Lamp Suspended Vertically.

The first and simplest case to be dealt with is that in which the lamp is suspended vertically downward and the point under consideration lies just underneath the lamp (at the foot F of Fig. 1.) In this case $r = 0$, so that the equation assumes the well-known form

$$\lambda = \frac{U}{h^2} \qquad (1a)$$

For $U = 80$ candles and $h = 8$ ft, $\lambda = 1.25$ ft-candles.

In the second case, which is the one most frequently encountered in connection with the usual calculations, the lamp is suspended vertically downward and the point under consideration lies at some distance, d, from the foot of the illuminant, as indicated in Fig. 1. The light intensity in the direction of the point is determined by the polar candle-power curve to be ES. Its projection, EP, on the vertical axis of the lamp gives a value of $U = 50$ candles. Hence, according to equation (1), the illumination is

$$\lambda = \frac{50}{64 + 36} = 0.5,$$

the height of suspension being 8 ft. and the distance $d = 6$ ft.

The third case is that of an inclined light source with the point under consideration in a vertical plane through the axis of the illuminant. This case is indicated in Fig. 2, where EG

represents the axis of the inclined illuminant and M the point under consideration, EM being in the same plane as EFG. In this case the conditions are similar to those of the last. The polar candle-power curve indicates on the vector EM a light intensity ER, the projection of which gives $U = 48$ candles. Inasmuch as $d = FM = 10$ ft. and $h = 8$ ft.

$$\lambda = \frac{48}{100 + 64} = 0.29.$$

The fourth case is the one discussed by Mr. Albert F. Parks in the article mentioned above. The source of light is inclined and the point under consideration does not lie in the vertical plane through the axis of the inclined illuminant. This case is somewhat more complicated than the former, inasmuch as the various quantities do not lie in the same plane, thus involving the geometrical conception of space. However, the equation given above is nevertheless correct, but the determination of the light intensity in the direction of the point under consideration must be derived and properly transferred for the computation of its vertical projection. For a simple illustration, the diagrammatic representation of the problem by Mr. Parks is adhered to and reproduced in Fig. 3, while the graphical method as suggested by the present writer is illustrated in Fig. 2. The same letters in Fig. 2 and 3 refer to corresponding points, with the difference that the quantities in Fig. 2 represent true values, while Fig. 3 gives only a perspective representation. The source of light is inclined at an angle of 40 deg. with the vertical, its center being 8 ft. above the floor. A vertical plane through the axis of the source of light determines the triangle EFG, exactly as in the third case. The point M, however, is 6 ft. in front of and 8 ft. to the left of the lamp. While thus the distance d from the foot F of the lamp equals again 10 ft., as in the last case, the triangles EFG and EFM do not lie in the same plane, but are displaced, as indicated by the triangle GM_1F (Fig. 2). EMF represents a triangle determined by a vertical plane through the ray of light pointing in the direction of M, which is 6 ft. in front of the plane EFG. The actual

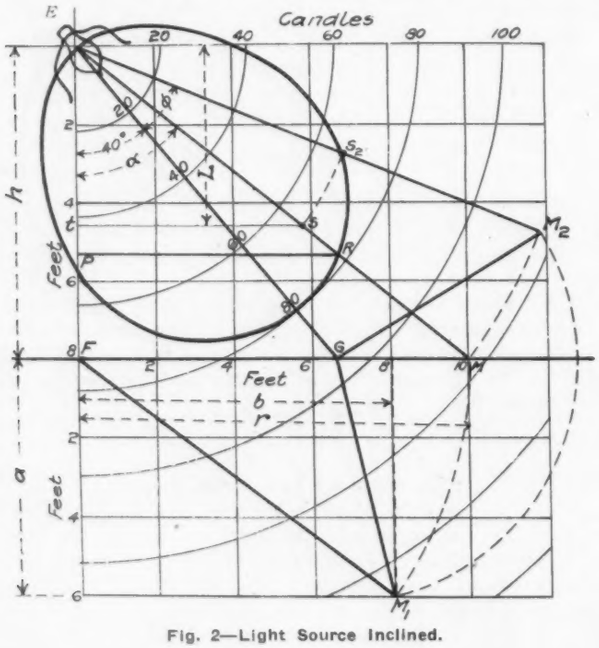


Fig. 2—Light Source Inclined.

value of the light intensity in this direction is determined by the triangle EGM_2, and the polar candle-power curve is plotted with EG as axis. This leads to a candle-power $ES_2 = 67$, which latter transferred back to ES on EM has a vertical projection of $ET = U = 42$ candles. Applying now the above equation

$$\lambda = \frac{42}{64 + 100} = 0.255,$$

which is the same value as obtained by Mr. Parks.

This method requires no special chart, but one of the standard polar papers may be used, preferably a kind on which a rectangular system of co-ordinates is superposed. A further advantage is perhaps its lucidity, inasmuch as one can easily imagine that the triangle EGM_2 and FGM_1 swung around EG and FG until GM_1 and GM_2 coincide, thereby leading to a pyramid $EFGM$, as shown in Fig. 3.

The mathematical proof of the correctness of the above equa-

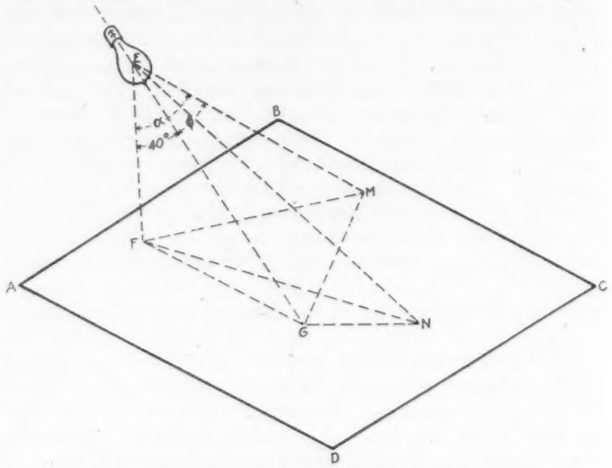


Fig. 3—Diagrammatic Representation of Problem.

tion and its application is hardly required, because the equation is nothing other than an adaptation of the well-known law of the inverse squares. The differences are the following: Instead of considering the direct distance between the lamp and the point, the height of suspension h and the distance d between the foot of the lamp and the point are introduced—values which can most easily be ascertained. Furthermore, use must be made of the vertical projection of the light intensity, owing to the fact that the illumination of a horizontal plane is being considered and this is not normal to the incident light vector, but inclined thereto, the plane thus receiving an illumination which is as much smaller than the normal as the vertical projection of the light intensity reduces its original value. In the equation above U represents the actual candle-power for normal illumination and its horizontal projection for vertical illumination.

One can thus easily appreciate that the above equation holds good not only for the horizontal illumination, but also for the normal and vertical illumination, and that the equation has practically universal application to all illumination determinations made according to the point-by-point method.

It should be noted that the illumination referred to above is always only the so-called direct illumination; that is, the illumination which is produced by the light directly issuing from the illuminant, without taking into account the additional indirect illumination having its origin in the light reflected from the walls and ceiling.

NEW TELEPHONE PATENTS.

NEW APPARATUS.

For a long time the telephone receiver diaphragm has departed little from standard form, namely, a thin circular plate of magnetic metal. It has been recognized that the thinness of the plate did not give the best magnetic efficiency, yet a thickening of the diaphragm introduces a more than corresponding falling off in the mechanical efficiency. In the endeavor to obviate these difficulties, a receiver has been patented with a composite diaphragm. The foundation is the usual thin plate. Upon this concentrically placed are a pyramid of plates, each thin and each with a smaller diameter than the one below it. All are secured by a single control rivet. Thickness and flexibility are thus combined. The patent is granted to Mr. C. W.

Chamberlain, of St. Louis, administrator for the inventor, J. Noble, deceased.

In the illustration is shown a ringer patented by Mr. P. C. Burns, of Chicago. The novel features lie in the double polarizing magnets and in the method used in supporting the armature. The ringer is of the harmonic type and the spring provides a mounting such that the bell clapper comes to rest in mid position away from both gongs.

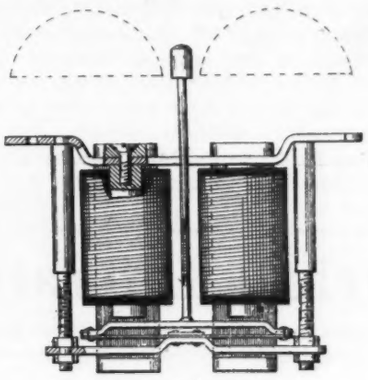


Fig. 1—Burns Ringer.

An invention of Mr. H. H. Berg-Jager, of Norway, covers a detachable mouthpiece extension for transmitters. It consists of a conical extension piece which has a cushion ring at its small end. When pushed into the regular mouthpiece, the rubber cushion becomes slightly compressed and holds the parts together.

SELECTIVE PARTY LINE SYSTEM.

Among the several selective party line schemes of ringing one which had considerable use was a four-party pulsating current system. The polarized bells are given an initial pull in one direction by a spring. An impulser of a given polarity will overcome the spring and cause a throw of the hammer against one bell, while during an interval of no current between pulsations, the spring acts to return the hammer. Two such bells oppositely poled rung from each side of the line to ground serve to provide for the selection. If each such pair of bells be supplemented by a direct-current bell which will not respond to the impulses, a six-party system is made possible. This system has been patented by Mr. F. E. Winslow, of Des Moines.

IMPROVED TRANSMITTER.

Mr. P. G. Randall, of Malden, Mass., has patented a transmitter. The rear electrode is carried upon the end of a slip spring, while the front electrode is upon the rear face of the diaphragm. A felt pad occupies the intervening space. The pad has several circular perforations in each of which granular carbon is placed. Thus several distinct bodies of granules are worked in parallel.

REPEATER CIRCUIT.

A repeater circuit comprises the invention of Mr. P. Stragiotti, of Hurley, Wis. The line is cut in two at the repeater station, the two portions being similarly connected. Each portion is connected to a repeating coil. The other winding of this is connected to a second coil and then beyond this latter is an artificial line of constants like those of the corresponding line branch. Between the two coils on each side, the repeater circuits are cut in, in such a manner as to prevent humming. This humming is overcome through the special inductive and potential relations of the coils and wiring of the repeater.

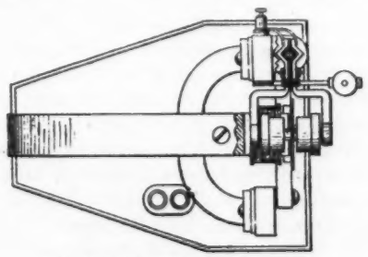


Fig. 2—Stragiotti Repeater.

REPEATER.

Under the name translator, Mr. P. Stragiotti, of Hurley, Wis., has patented a form of repeater. This is designed for use upon a double circuit—that is to say, there is an individual line circuit for transmission in each direction. A frame pivoted upon a vertical axis carries the stationary parts of the two microphone buttons which are used. These latter oppose each other in position and their front or movable electrodes are connected by a common spindle at the middle of which is an armature plate. This latter is supported independently of the movable frame. Its support is from its corners, these being drawn out into thin tongues. The illustration gives an idea of the arrangement. The microphones are connected up to act differentially.

TELEPHONE SUPPORT.

Mr. T. W. Small, of Cleveland, has invented a telephone receiver support, the patent for which is assigned to the Acme Automatic Street Indicating Company. This is adapted to clamp to a desk stand and to hold a receiver to the ear of the user. The arm has the usual adjustments and in its lowered position it depresses the hook lever.

ANTISEPTIC DEVICE.

An antiseptic mouthpiece forms the subject of a patent granted to A. K. Young of Pittsburg. A small threaded aperture is made in the wall of the mouthpiece near its base. Into this there is screwed a small cartridge-like antiseptic container. A passage is made through the stud of the container and leads into the mouthpiece cavity. The container extends downward close to the transmitter face. It is not unsightly and is out of the way.

An antiseptic device has been patented by the Messrs. L. Rosenwald and J. H. Anthony, both of Kansas City. The device consists of an inner mouthpiece which is closed to form an antiseptic-containing receptacle. It is pivoted so that the rising switch hook throws it up out of the way, while it is restored before the mouthpiece when the receiver drives down the hook. During each swing of the device the antiseptic solution has a momentary access to an absorbent layer of the device.

Mr. B. C. Maxwell, of Canton, Ohio, has arranged a different sort of protection. He provides an inner mouthpiece readily attachable to the regular one, and there is thereby formed an air passage between them. The lip of the inner mouthpiece is turned back over that of the regular one, so that the air passage opens away from the user. The air currents incident to speaking drive contaminations out through the air passage.

Mr. W. Whitten, of Schenectady, has invented the rather novel form of transmitter shown in the accompanying illustration. Four carbon chambers are arranged through the use of five auxiliary diaphragms, two of which are arranged to have considerable inertia. Carbon granules on one side of one of these loaded diaphragms are compressed by an approaching light diaphragm, while that on the other side is virtually left

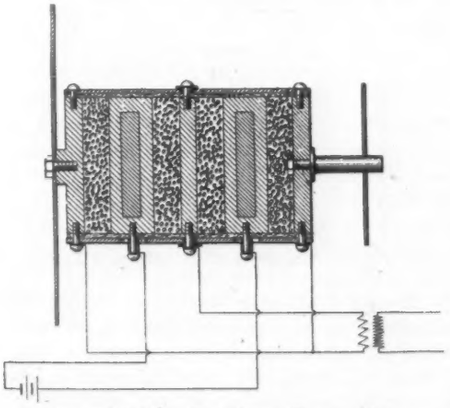


Fig. 3—Whitten Telephone Transmitter.

free and of great resistance. By keeping this in mind while tracing out the primary circuits, it will be seen that an alternating current is produced in the primary circuit.

Letter to the Editor.

Loss of Light From Dirty Reflectors.

To the Editor of Electrical World:

Sir:—Permit me to call your attention to a typographical error on page 986 of your issue for April 21, 1910. In the report of the April meeting of the Chicago Section of the Illuminating Engineering Society there is the following paragraph:

"Mr. Henninger stated his opinion that the ideal window lighting has no lamps exposed, thus producing the effects seen on the stage in theaters. He stated as his conclusions, after carrying on extensive tests on loss of light due to dust and dirt, that in some downtown districts or cities dust will cause a depreciation of illumination amounting to 70 per cent in from four to six months."

The figure of 70 per cent is in error. The statement, as made, was that in some of the downtown districts of cities the loss of light due to dust and dirt collecting on lamps and reflectors will in some extreme cases during a period of four or six months amount to about 30 per cent, or the resultant intensity of illumination will be about 70 per cent of the initial value, i.e., when lamps and reflectors were clean.

Cleveland, Ohio. J. G. Henninger.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Polyphase Commutator Motors.—J. Jonas.—An illustrated paper read before the Electrical Society of Frankfurt. A new impetus has been given to the design of polyphase commutator motors by using the latter as an adjunct to an induction motor in order to procure speed regulation with high efficiency. The general theory of the polyphase commutator motor is given with special reference to the methods of speed regulation of polyphase series and shunt-wound motors. Fig. 1 shows the combination of an induction motor *H* with a commutator motor *K*. The latter need not be designed for the whole power, but only according to the amount of speed regulation required. For a 10 per cent speed regulation the commutator motor *K* is to be designed for only 10 per cent of the total rating of *H*. In Fig. 1, *H* is the main induction motor, the stator of which is connected to the network *N*, while the slip rings *S* are connected to the three-phase commutator motor *K*. The main induction motor *H* thereby assumes completely the character of the commutator motor. If *K* is a series motor, the main motor *H* has also series motor characteristics. If *K* is a shunt motor *H* has also shunt motor characteristics. The total energy consumed by *K* is given off again as mechanical energy to the common axle of the two motors. If the efficiency of the main motor *H* alone is 92 per cent and if it is desired to regulate the speed 20 per cent downward with equal output, about 20 per cent of the power is consumed by the commutator motor. If the efficiency of the latter is 85 per cent then 17 per cent of the power is given back to the axle in the form of mechanical

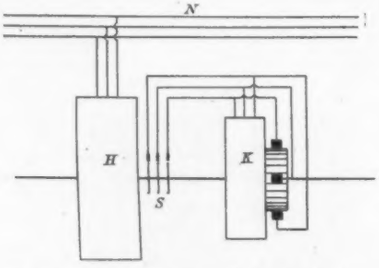


Fig. 1—Polyphase Commutator Motors.

energy. The total efficiency is therefore diminished by only 3 per cent and is in the whole still about 89 per cent. A different method of speed regulation is shown in Fig. 2. This method is useful where for some reason it is impossible to place a commutator motor on the axle of the chief motor *H* or where an induction motor *H*, which is already in operation, is to be converted into an adjustable-speed machine. In this case a motor-generator set *KA* can be placed anywhere within the machine-room or outside of it. *K* is the commutator motor which receives the current from the slip rings *S* of the induction motor. The generator *A* coupled to *K* may be an induction machine, or a synchronous machine, or a commutator machine. A disadvantage of this arrangement is that with a given main motor, speed regulation is possible only with constant torque, so that the permissible output decreases with the speed. If constant output is specified, the main motor must be designed for the lowest speed, on maximum torque. The efficiency of this combination is somewhat less than that of Fig. 1. The author discusses the advantages of these two

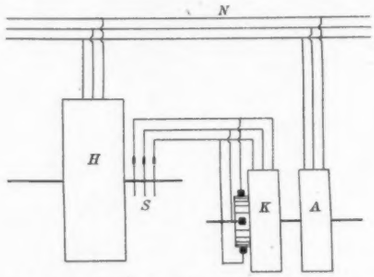


Fig. 2—Polyphase Commutator Motors.

arrangements, combining an induction motor with a commutator motor over a single commutator motor, the methods of avoiding sparks and phase compensation.—*Elek. Zeit.*, April 21.

Direct-Current Turbo-Generator.—An illustrated description of a direct-current turbo-generator built by Parsons & Company for the Brussels exhibition. The normal output of this machine is 1000 kw at 550 volts, and it is designed to run at a speed of 1800 r.p.m. The armature winding consists of solid conductors firmly locked into dove-tailed slots in the core, a portion of the conductor being external to the core and a portion being embedded into it. This arrangement provides a particularly satisfactory cooling for the windings and commutator. The magnet system is provided with a compensating winding fitted to the pole pieces of field magnets having definite poles. It is wound round the axis at right angles to the ordinary polar axis carrying the ordinary field windings, and is usually so designed as to have about twice the number of ampere-turns that there are in the armature winding. No commutating pole is used, and there is no iron between the pole pieces. Satisfactory commutation is obtained at all voltages between 440 and 600 without any adjustments. An overload of 50 per cent can be carried for short periods, and 25 per cent for one hour.—Lond. *Engineering*, April 22.

Regulators for Alternators.—M. Seidner.—The conclusion of the English translation of his recent German paper on various automatic regulators for alternators.—Lond. *Elec.*, April 22.

Lamps and Lighting.

Metallic-Filament Lamps for Street Lighting.—A summary of the results obtained in various English cities with street lighting by high-candle-power metallic-filament lamps. H. Tomlinson-Lee reports the results obtained in Wimbledon, where at present there are 91 flame-arc lamps and 1136 metallic-filament lamps. These latter are in all cases osrams, and comprise 44 of 300 cp (330 watts) and 1092 of 50 cp (55 watts to 63 watts). Special mains have been laid for supplying energy to the street lighting system, and duplicate trunk mains are run from the power station, one of these trunk mains serving as a standby. Switching on individual lamps or circuits is in this way rendered unnecessary, the whole of the street lighting being controlled simultaneously from the supply station. The 300-cp osram lamps have been substituted in most cases for enclosed arc lamps, and the existing arc-lamp columns have been utilized. This arrangement results in the lamps being about 18 ft. from the ground, and the light is distributed over an extensive area. To increase the efficiency of the distribution, prismatic reflectors have been fixed over the 300-cp lamps. The light is absolutely steady and the lamps require practically no attention. The osram lamps of 50 cp are used for side-street lighting and are situated from 180 ft. to 210 ft. apart, at a height of 12.5 ft. above the road. In all cases the existing lanterns and columns, which had done duty in the days of gas and subsequently of oil, have been utilized. No reflectors or special fittings are necessary. The e.m.f. of the supply is 220 volts in the case of the incandescent lamps, while a separate transformer is installed at the base of every arc lamp, these latter taking about 550 watts each. Four charts are given showing the gradual failure of lamps installed at a certain time. The results with 93 50-cp osram lamps installed on

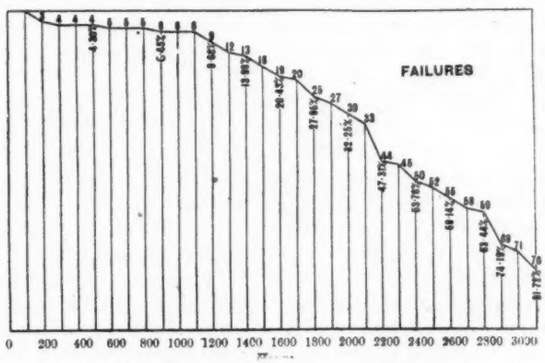


Fig. 3—Chart Showing Lamp Failures.

Sept. 15, 1908, are shown in Fig. 3. After 1100 hours it will be noticed that 6 lamps, or 6.45 per cent of the total, had failed; after 2000 hours, 30 lamps, or 32.25 per cent, while after 3100 hours, 76 lamps had failed—that is to say, at the conclusion of the chart (that is, after 3000 hours) 17 lamps, or over 18 per cent of the total, were still in use. The results obtained in other cities and with other types of lamps are also given.—Lond. *Electrician*, April 22.

Metallic Oxides for Arc-Lamp Electrodes.—B. MONASCH.—After a review of articles and patents on the use of metallic oxides in arc-lamp electrodes the author gives an account of experiments with electrodes in which powdered magnetite was mixed with various other metallic oxides. The powdered mixture was pressed together and filled into a cylindrical iron tube 10 mm in diameter and 0.2 mm in thickness. This tube was used as the lower electrode and was the cathode. The upper electrode, the anode, was a slab of copper, 5 mm thick and 15 mm in diameter. The results obtained with a great many different oxides are shown in diagrams. The addition of most of the oxides studied has the effect of reducing the light from the magnetite and it is proportionately diminished the greater the addition of foreign material. It is only the oxides of certain rare metals, such as CeO_2, Y_2O_3, V_2O_5, TiO_2, VO_2, WO_2, WO_3, as shown in Fig. 4, which exhibit a higher luminous effect than magnetite. As to the addition of zirconium oxide to magnetite, the diagram shows that additions up to 60 per cent improve the candle-power of the magnetite arc, but higher percentages cause diminution. It seems that in this improvement of the luminous efficiency of the arc by the addition of various metallic oxides, the phenomenon is somewhat similar to that which is to be noted in the effect of mixtures of oxides in the incandescent gas mantle. An incandescent mantle composed of thorium oxide alone is known to give practically no light at all. The high luminous efficiency of the mantle is due to the addition of small traces of cerium oxide. Thus the addition of 1 per cent of cerium to 99 per cent of thorium oxide gives rise to the maximum luminous effect, but each addition of cerium oxide beyond this point causes the light to diminish more and more; eventually, when 10 per cent of cerium oxide has been added, there is again practically no light produced. Titanium oxide (TiO_2) is an excellent light producer. The diagram shows that each addition of this material to the magnetite causes an improvement in the light until the maximum effect is reached by the pure titanium oxide alone. Finally, experiments were made with carborundum, fire clay and kaolin. Pure metals were found to be relatively poor producers of light.—*Illumin. Engineer* (Lond.), April.

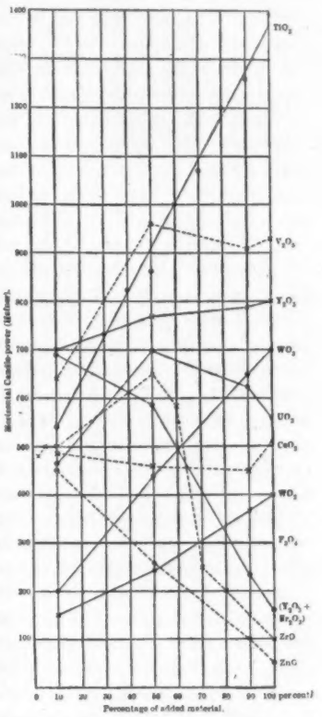


Fig. 4—Curves Showing Effect of Addition of Various Oxides.

Gas Versus Electric Lighting in London.—An account of the acceptance by the Westminster City Council (London) of the Gas Light & Coke Company's tender for lighting Regent Street, Piccadilly, and neighboring thoroughfares, in spite of the fact that the electric lighting of Regent Street has been a pronounced success from every point of view. The Gas Light & Coke Company tendered an extremely low price which, it is thought, must be considerably under cost, when everything is taken into account. In the case of the 90-cp unit, the smallest for which a price was given, the Gas Light & Coke Company offers to maintain a lamp of this rating for a period of 15 years for a sum of $13.12 per annum (3940 hours). Now, Mr. J. W. Bradley, city engineer of Westminster, as a result of tests made by him on the street lighting in Westminster, showed that a gas lamp giving on an average 83 cp cost $9.62 per annum to maintain, exclusive of the cost of the gas. Taking this figure in the present instance it is found that a sum of $3.50 per lamp per annum is left to pay for the gas. According to Mr. Bradley the type of lamp under consideration consumes 7.5 cu. ft. of gas per hour, so that the gas company is supplying gas for street lighting in this instance at a price of 11 cents per 1000 cu. ft.—a rather different figure from the 70 cents which the ordinary private consumer is charged, and from the 60 cents which the City Council has been paying up to the present for practically identical lamps in Victoria Street. With regard to the cost of maintaining high-candle-power lamps, Mr. A. A. Voysey, electrical engineer to the city of London, showed that a 3000-cp gas lamp cost the corporation $230 per annum. The Gas Light & Coke Company proposes to maintain a similar lamp in Westminster for a sum of $101.25 per annum, gas being included in both cases. The discrepancy

is somewhat large. The comparison of gas and electric systems shows a large sum in favor of gas, but this sum includes the laying of new cables for electric lighting, while in the case of gas the mains are already laid.—Lond. *Electrician*, April 22, and Lond. *Elec. Eng'ing*, April 21.

Direct Measurement of Mean Spherical Candle-Power by Diffusion Methods.—W. E. Sumpner.—A paper read before the (Brit.) Illuminating Engineering Society. The Ulbricht integrating globe gives good results, but there are some sources of error. The present author has proven the following general principle: "If any complete (or if any portion of a) spherical surface be illuminated in any manner by the direct rays of a combination of light sources, the actual illumination I will exceed I_0 (the initial illumination) by a constant amount all over the sphere, owing to the reflective action of the surface." If, instead of the Ulbricht globe, use is made of a rectangular box surrounding the lamp and lined with a good white reflecting surface (white paper or white enameled iron) there is not any simple, accurate formula connecting I with I_0, as in the case of the sphere. The author shows, however, that the rectangular box may be used in different ways for photometric measurements. One method is as follows: The rectangular box rests with two of its surfaces horizontal, and the lamp is placed at the center of the box with its axis of symmetry vertical. There are four vertical planes through the axis, each of which divides the surface of the box into two halves, and on each of these halves the total light received is the same. If *ABCD*, Fig. 5, is a horizontal section of the box and *O* represents the axis, the four planes in question are represented by the two diagonals and by the two central planes parallel to the sides. The light received by the portion of the surface consisting of the vertical strip *AP*, and the two horizontal triangles *AOP*, will always be a fixed fraction of the total light emitted by the lamp, and in the case of a box of square section this fraction will be $\frac{1}{8}$ $(1-\delta)$ or $\frac{5}{8}$ if δ is 80 per cent (δ is the reflecting power). Now suppose the box is formed of wood, and that its internal surfaces are well whitewashed. Suppose the part of the box represented by *AOP* is cut out, and that in its place is fixed a framework supporting three surfaces replacing the missing portions of the box. Let these surfaces consist of a substance transmitting and diffusing light such as opal glass or engineers' tracing cloth. The light received by these new surfaces will still be a fixed fraction of the total light emitted by the lamp, and this will also be true of the amount of light diffused outward. All that remains to do is to arrange some suitable way of illuminating a photometer by this outwardly diffused light. This object can be attained by the use of two good mirrors, one touching the top and the other the bottom of the box along an edge parallel to *SO*. Each mirror should be inclined 45 deg. to the surface of the box so as to reflect the light from each triangular area *AOP* along the line *OP*. The photometer should be placed along the line *OP* produced, and from its position the appearance will be that of three flat bright surfaces, each perpendicular to the line of the photometer. If the box is a yard cube the size of these surfaces will be considerable, and the photometer distances will have to be large for accuracy. This will be no novelty in arc-lamp testing, since the intensity of the light necessitates large photometer distances. For incandescent-lamp testing the dimensions of the cube can be made much smaller, as can also those of the rest of the apparatus.—Lond. *Electrician*, April 22.

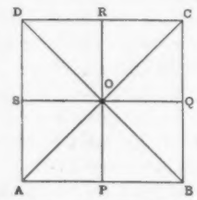


Fig. 5—Horizontal Section of Box.

Generation, Transmission and Distribution.

Water-Power Plant in Italy.—A note stating that the equipment of an electrical power station to utilize the water-power of the river Pescara, in the neighborhood of Torre del Passeri, is now in progress. The plant will comprise four three-phase generators, each of from 8200 hp to 9000 hp, delivering energy at from 6300 volts to 6600 volts, with a frequency of 42, when running at 420 r.p.m. These sets will be directly coupled to water turbines. There will also be two 400-kw exciter machines, each delivering energy at 220 volts when running at 600 r.p.m.; and seven 3600-kva single-phase transformers, six of which are combined in two three-phase sets (star connection), while the seventh serves as a stand-by. These single-phase transformers are calculated for a ratio of 6000 volts to 46,200 volts, or (with constant output) 6600 volts to 51,000 volts, and are insulated for 90,000 volts. The resultant phase e.m.f. at the secondary terminals is 80,000 volts and 88,000 volts respectively. The whole of the electrical energy generated at the station is to be conveyed through a double line about 125 miles long to Naples, where the e.m.f. will be reduced in a substation partly to 5300 volts for the city of Naples and partly to 27,000 volts for the transmission of energy to Torre-Annunziate.—Lond. *Electrician*, April 22.

Water-Powers of Sweden.—A. V. Clayton.—A paper read before the (Brit.) Inst. Elec. Eng. After drawing attention to the characteristics of Sweden the author refers to the development of energy transmission systems in that country. He then proceeds to describe typical installations, mentioning the features of particular interest. In the present installment some details are given of the water-power plants of Alby (calcium carbide and chlorate works), Ringdalen, Gullspang (2500 hp), Graninge (5000 hp). With the exception of a few electrochemical works, where a low frequency is necessary, 50 cycles has generally been accepted as the standard. The new State power scheme at Trollhattan, is, however, designed for 25 cycles, partly with a view to the use of the energy for railways. The city of Stockholm primary transmission is also at 25 cycles, but with these exceptions it may be said that for supply companies 50-cycle three-phase is universal. The paper is to be concluded.—Lond. *Electrician*, April 22.

Water-Power Stations.—F. Koester.—A second article of the author's serial on hydroelectric engineering practice. In the present installment he deals with head races, pressure pipes and penstocks.—*Eng. Mag.*, May.

Wind-Power Generating Plant.—A note on a recent British patent (6752, 1909; April 14, 1910) of J. G. Childs and T. S. Hill. In a plant comprising a wind turbine, a dynamo, and a storage battery, the wind turbine is arranged to run at its most efficient speed for all values of the wind velocity by causing an increase in the current supplied to the battery to effect a decrease in the excitation. A number of series relays are adjusted to put resistance into the generator field circuit in successive steps, so that for high velocities of the wind the generator is running at a high speed with minimum excitation. A description is given of similar arrangement for switching in the end cells of the battery when the current rises. Alternatively the battery may be divided into two halves and connected in parallel for low speeds and in series for high speeds. An automatic switch effects the change-over, allowing a suitable interval for the pressure of the generator to increase. A double-commutator machine may be used, the two commutators being connected in either series or parallel.—Lond. *Elec. Eng'ing*, April 21.

Traction.

Single-Phase Traction in Germany.—A description with map of the new single-phase traction system on the road from Dessau to Bitterfeld in the province of Saxony in Prussia. This is part of the Magdeburg-Leipzig-Halle road. Single-phase locomotives will be used, the frequency being 15, the trolley voltage 10,000 and the transmission voltage 60,000. The power station will be located near Bitterfeld, containing a steam turbine, brown coal of the district being used. Two different kinds of locomotives are used, one for high speed and passenger service and the other for freight service. The power plant and the electric transmission line are in course of erection.—*Elek. Zeit.*, April 21.

Single-Phase Traction.—G. Revessi.—After a comparison of single-phase, three-phase, and direct-current systems, the author concludes that the real advantage of the single-phase system rests in the construction of the line, while with respect

to the power station there is no such decided advantage.—*La Lumière Elec.*, April 16.

Electric Equipment of Submarine Boats.—J. BREGUET.—The conclusion of his article on special designs of electric machinery for use on the new submarine boats of the French navy.—*La Lumière Elec.*, April 16.

Installations, Systems and Appliances.

The Electrical Industry in the United States and Germany.—W. FELLENBERG.—A continuation of his very long statistical serial. The author discusses the development of the electric manufacturing companies, their manufacturing and sales organizations, and compares the conditions in the United States and Germany. Curves are given on the output of three of the chief manufacturing companies, showing the yearly outputs of the General Electric Company to be first, the Allgem. Elek. Ges. of Germany to be a close second, and the Westinghouse Company to be third. There has been a large increase of output during the last few years.—*Elek. Zeit.*, April 21.

Storage Battery.—An illustrated description of the new 12,000-amp-hour battery plant at the Dickinson Street station of the Manchester Corporation. This comprises a Tudor battery of 210 cells, three reversible boosters, and the necessary switchgear. The latter is especially interesting on account of the heavy currents dealt with. Aluminum busbars are employed, and the connections with the switch contacts and with the cables are on new lines. The battery will run in parallel with the traction generators during the day and take in the surplus energy automatically. During the early hours of the morning it will take the whole traction load, and in the evening the lighting load peak. The battery gives 8400 amp for one hour, 5000 amp for two hours, 3900 amp for three hours, and 11,200 amp for half an hour. It will withstand a maximum discharge rate of 15,000 amp. The normal charging rate is to be 4100 amp, and the maximum charging rate 6500 amp. The battery manufacturers have entered into an agreement to maintain the battery at 100 per cent of its rated output for a period of 10 years on the basis of 7.5 per cent of the purchase price. An efficiency of 85 per cent in amp-hours, or 75 per cent in watt-hours, when the total output is not less than three-quarters of its rated capacity, is guaranteed.—Lond. *Elec. Eng'ing*, April 21.

Wires, Wiring and Conduits.

Insulation of Fine Wires.—A note on a recent British patent (18,193, 1909; April 14, 1910) of P. A. Newton (Farbenfabrik F. Bayer & Company, of Germany). Wires or strips are first covered with thin tissue paper or cotton, and are then passed through a 10 per cent solution of acetylized cellulose. The paper or cotton causes the insulating compound to adhere to the wire—Lond. *Elec. Eng'ing*, April 21.

Electrophysics and Magnetism.

Weight and Electrification.—L. SOUTHERNS.—A paper read before the Cambridge Philosophical Society, giving an account of an experiment in which the author made an attempt to detect change of weight due to electrification. The experiments appear to show that a body positively charged with 20 electrostatic units of electricity behaves as though it were heavier than the same body negatively charged by an amount of the order to 0.0007 milligrams.—Lond. *Electrician*, April 22.

Shunting Inductance Coils.—G. W. O. HOWE.—An article illustrated by diagrams in which the author shows geometrically that although the effective resistance under certain conditions may be increased by shunting a highly inductive coil by a non-inductive resistance, the impedance is not increased.—Lond. *Electrician*, April 22.

Beta Rays.—W. A. BORODOWSKY.—While the absorption of beta rays from radium by metals and solids has been studied in detail, little attention has been given to the absorption of the beta rays by solutions of liquids. The present author has studied this absorption in solutions of calcium chloride, cane sugar, and in other solutions, and has reached the following conclusions: The activity of the beta particles after passing through layers of solutions is independent of the chemical or physical state of the solutions. The method of comparing absorption in terms of aluminum may be applied to homogeneous or non-homogeneous rays and consequently gives comparative results quite independent of the coefficient of absorption. The absorption is directly proportional to the mass of matter traversed. The absorption of the salt is directly proportional to the amount of salt present in solutions. Solutions absorb beta rays according to the same laws as solids. The absorption by compounds follows an additive law. Relative absorption depends upon the internal structure of atoms, but is independent of the arrangement of the atoms in the molecules.—*Phil. Mag.*, April.

Fluorescence and Conductivity.—H. E. HOWE.—An account of an experimental investigation the object of which was to determine whether fluorescence has any effect on the electrical conductivity of anthracene vapor. The result of the experiments was negative in so far as it was impossible to detect any conductivity of the vapor, either unilluminated or fluorescent.—*Phys. Rev.*, April.

Pressure of Electric Wind in Hydrogen Containing Traces of Oxygen.—A. P. CHATTOCK AND A. M. TYNDALL.—An account of an experimental investigation the chief results of which are as follows: The gradual removal of the last 1 per cent of oxygen from hydrogen gives rise to a marked fall in the electric wind when a negative point discharges through the gas against a plate. This fall is probably due to discharge of positive electricity from the plate and may even amount to a slight reversal of the wind in very pure hydrogen. The fall is accompanied by a glow upon the plate which may be regarded as further evidence for such back discharge. Within the same limits of percentage change of oxygen the straight part of the negative wind pressure curves becomes shifted parallel to itself through a distance which may amount to 3 cm. It is suggested that this shift may be associated with the growth of the ions from the corpuscular magnitude to that of the ordinary negative ion. None of the above effects occur with positive discharge in hydrogen, which is practically uninfluenced by the presence of oxygen up to the highest percentage (3.7) used.—*Phil. Mag.*, April.

Point and Plane Discharge.—R. F. EARHART AND CHAS. H. LAKE.—When an electrified point is separated from a plane positively electrified a sufficient potential difference may be attained to produce a discharge, and if the point is positive the potential difference required for the discharge will be greater than if the point is negatively electrified. The present authors have made quantitative measurements of the rectifying effect between an electrified point and a plane, both in air and in hydrogen, at different atmospheric pressures. In air the conditions appear to be most favorable near the critical pressure and for a long spark gap. The results obtained for hydrogen are quite similar to those obtained in air, but the minimum potential required for the discharge is considerably less than for air and occurs at higher pressure.—*Phys. Rev.*, April.

Selenium.—LOUISE A. MCDOWELL.—An account of a continuation of her researches on some electrical properties of selenium. In the present installment an investigation of the recovery from excitation by Röntgen rays is recorded. The forms of the recovery curve for X-ray excitation and for light excitation are identical. The form of the recovery curve for excitation by light depends on the magnitude of the initial change in conductivity and not at all upon the time required to produce that change. The rate of recovery from excitation by X-rays is slower than from excitation by light. Hence, diffusion is probably not an important factor in producing the deviation from the straight line of the selenium recovery curves.—*Phys. Rev.*, April.

Bending of Electric Waves.—J. W. NICHOLSON.—A highly theoretical paper on the theory of the bending of electric waves round a large sphere.—*Phil. Mag.*, April.

Secondary Radiation.—W. B. HUFF.—An account of an experimental investigation of typical cases of secondary radiation excited by uranium X-rays.—*Phys. Rev.*, April.

Electrochemistry and Batteries.

Metallic Zirconium.—Weiss and Neumann.—An account of an experimental investigation in which the authors have succeeded in preparing fused zirconium in a pure condition. The metal has been previously known only as an impure powder, or containing much carbon when fused. This difficult operation was performed, after many failures, by compressing the powder into pencils and passing an electric arc from the end of one pencil to another, either in a vacuum furnace containing hydrogen under very low pressure or in the same apparatus containing an atmosphere of nitrogen or ammonia. The upper pencil, forming the positive pole, was fused and the metal dropped upon the lower electrode, forming a stalagmite-like mass which was sometimes 3 mm or 4 mm in diameter and 2 cm or 3 cm in height. The light produced at the melting point was so intense that the eyes had to be protected by very dark glasses when the operation was watched through the window of the apparatus. The fused zirconium was somewhat tarnished, but the fracture was white and metallic like cast iron. It was slightly harder than quartz, and decidedly less hard than Moissan's product containing carbon. It was very brittle, with a specific gravity of 6.4. The specific heat was found to be 0.0804, a value considerably higher than any previous determination and giving an abnormal atomic heat, 7.316. It burns in air, and the average heat of combustion was found to be 1958.7 cal.—*Zeit. Anorgan. Chemie,* Vol. 65, page 248; abstracted in *Amer. Jour. of Science,* May.

Dyeing.—W. W. H. Gee and W. Harrison.—A Faraday Society paper proposing an electrical theory of dyeing, the basis of which is that when any two bodies are placed in contact they are oppositely electrified.—Lond. *Electrician,* April 22.

Units, Measurements and Instruments.

Logarithmic Paper.—O. Weisshaar.—An article on the use of logarithmic paper in electrical engineering. Logarithmic papers are such square section papers in which the axis of the ordinates or the axis of the abscissas, or both, are provided with a logarithmic (slide-rule) scale. The author shows how such paper can be used very conveniently for the plotting of curves which follow approximately a logarithmic or an exponential law. The use of such paper in electrical engineering is especially recommended for the plotting of magnetization curves and iron-loss curves.—*Elek. Zeit.,* April 21.

Measuring Sound.—F. R. Watson.—An illustrated description of a portable and easily adjustable apparatus for measuring sound, as shown in Fig. 6. It consists of a telephone receiver connected in series with a thermo-galvanometer. Feeble

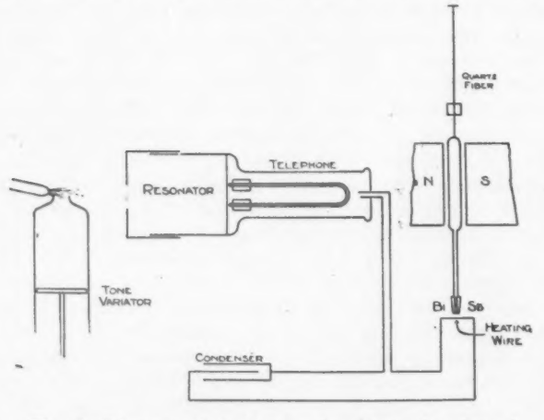


Fig. 6—Diagram of Apparatus for Measuring Sound.

sounds are augmented by altering the apparatus so as to make it resonant. The source of sound is adjusted until a maximum deflection of the galvanometer is obtained. A resonator is then mounted on the telephone plate and adjusted to give a second maximum deflection. The electric circuit is also tuned by inserting a condenser and altering the capacity to get a third maximum. Finally, the distance between the telephone plate and the telephone magnet is adjusted for the greatest effect. The Duddell thermo-galvanometer is especially suited for this work, as it gives a steady deflection for the alternating currents set up by the telephone. As the source of sound use is made of a tone variator consisting of a hollow brass cylinder open at the top and closed at the bottom by an adjustable piston. The telephone receiver is one of an ordinary bipolar type. The resonator is a hollow brass cylinder.—*Phys. Rev.,* April.

Wehnelt Interrupter Shunted by Capacity.—C. Deguisne and P. Ludewig.—If an inductance coil is operated by direct current, the rotating interrupter in the primary circuit is generally shunted by a condenser, since the length of the secondary spark is thereby increased. When the Wehnelt interrupter is used, the condenser is unnecessary and it is even better not to use it. By means of the oscillograph the authors have investigated what happens when the Wehnelt interrupter is shunted by a condenser.—*Phys. Zeit.,* April 15.

Induction Meter.—An official communication of the German Reichsanstalt by which three single-phase and one three-phase induction meters of the Isaria Meter Company are admitted for calibration, their connections and construction being described.—*Elek. Zeit.,* April 21.

Recording Thermometers.—H. L. Callendar.—An illustrated description of an electrical recording thermometer for clinical work. It is of the electric resistance type and the thread recorder or the slide-wire recorder is used.—*Phil. Mag.,* April.

Barretter.—W. Kempe.—An article illustrated by diagrams on the barretter and its use as an indicator in electric oscillation systems.—*Phys. Zeit.,* April 15.

Telegraphy, Telephony and Signals.

Telephone Currents in Loaded and Unloaded Lines.—B. S. Cohen.—A paper and demonstration before the (British) Physical Society. The demonstration showed the relationship between the sent and received currents in telephone lines under the various conditions which occur in practice. By the aid of Kennelly's formulas it is possible to calculate the relationship between the sent and received currents under any conditions encountered in practice, and for some of the conditions used in the demonstration the calculated results had been obtained. Four essentials were necessary for the experiments shown: (1) A current comparable with the actual telephonic speech current. This was observed by means of a vibrating wire interrupter giving a wave with a fundamental of about 100 cycles per second with a damped oscillation of about 800 cycles per second superimposed. (2) A telephone line with or without its load in the shape of inductance coils. (3) Terminal apparatus: The lines were terminated by receivers and induction coils as used in practice for what is known as local battery working. (4) Current measures: For this purpose barretters arranged as alternating-current ammeters were used. The first experiment showed the relationship between the received and sent current for various lengths of standard cable unloaded. The second experiment illustrated the variation in the current sent when the receiving end was open or closed circuited and the length of the cable was varied. The third experiment showed the current distribution along the loaded cable by inserting a barretter at different points along the cable. The author gave explanations of the various phenomena illustrated in the experiments. He pointed out that it is now possible to make both calculations and quantitative telephonic tests which give mutual confirmation.—Lon. *Electrician,* April 22.

Microphone Transmitter.—A note on a recent British patent (4162, 1909; April 14, 1910) of S. G. Brown for a metallic powder microphone transmitter. Fragments of osmium-iridium, osmium, or ruthenium, are substituted for carbon powder in microphone transmitters, telephone relays, etc. As the resistance of such metals is low, the resistance of the rest of the circuit must be low. A microphone containing a single contact of osmium-iridium alloy, and other constructions with powdered metal between hard iridium faces, are described.—Lond. *Elec. Eng'ing,* April 21.

Spark-Gap for Wireless Telegraphy.—C. C. F. MONCKTON.—An account of experiments on the reception of radiotelegraphic signals when transmitting with a spark-gap in compressed air, as compared with signals received when an ordinary spark-gap was used. Contrary to expectations, the results appear to show that there is no advantage in using compressed air round the spark-gap. At the same time that the dielectric strength of the air is enormously increased, so also is the resistance to the oscillatory spark, both appear to increase at about the same rate.—Lond. *Elec. Eng'ing*, March 31.

Miscellaneous.

Filing System.—C. H. R. THORN.—An illustrated article on a system of classification and filing of technical information with special reference to electrical engineering.—Lond. *Elec. Rev.*, April 1.

Depreciation.—W. A. J. O'MEARA.—A paper read before the (Brit.) Inst. of Post Office Electrical Engineers. The author deals with the question of depreciation under the heads of physical decay, obsolescence, inadequacy, tenure of holding, reconstruction requirements imposed by legislation, and unforeseen expenditure arising from accidents, etc., and discusses the life of machinery and other plant.—Lond. *Electrician*, April 8.

McFarland.—A biographical sketch, with portrait, of Mr. Walter M. McFarland, formerly the executive of the Westinghouse Electric and Manufacturing Company.—*Elec. Jour.*, April.

Technical Education.—R. POHL.—A paper read before the (British) Association of Teachers in Technical Institutions discussing the movement toward a national system of technical education in England. The author thinks that organization on a national basis is indispensable to success.—Lond. *Electrician*, April 15.

World Exposition in Brussels.—A. HEYLAND.—A review of the electrical exhibits of the World's Exposition in Brussels now being held. Among the exhibitors Belgium and Germany are first, then follow England, France, Holland, Italy and Switzerland. The United States does not appear to be represented.—*Elek. Zeit.*, April 21.

New Apparatus and Appliances

UNIVERSAL DOMESTIC MOTOR.

Numerous efforts have been made to popularize the utilization of electricity in the home; and although small, serviceable and reliable motors have been devised for driving a sewing-machine, knife-cleaner, food-chopper, vacuum-cleaner, and whatnot, the main drawback has been that each machine required its own motor, which became a fixed attachment. Under such circumstances the cost of fitting electric motors to the various domestic machines in an average household is oftentimes somewhat prohibitive. This disadvantage, however, has been ingeniously overcome by the production of the "Electric Mary Ann," as it is facetiously called, which is the invention of R. Borlase Matthews, Bank Buildings, Kingsway, London, Eng. This machine comprises an electric motor, with a special speed reduction gear of simple design, which can be attached to and detached from any appliance in the home within a few seconds. Moreover, it is of light weight and does not occupy more space than a sewing-machine, so that it can be easily carried from room to room as required.

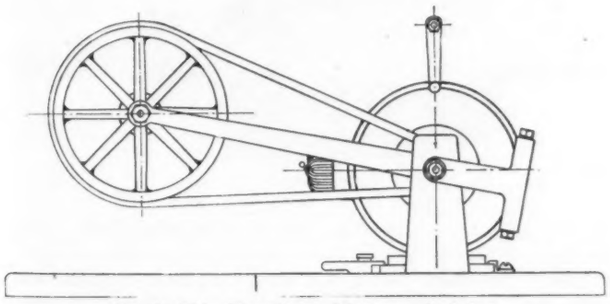


Fig. 1—Side Elevation of Universal Motor.

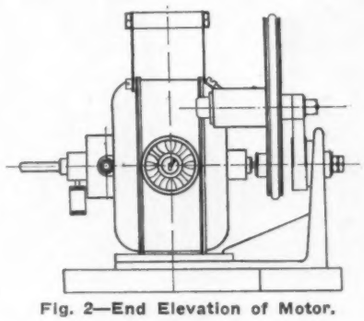


Fig. 2—End Elevation of Motor.

The motor is equipped with a swinging arm, one end of which is mounted concentrically with the axis of the motor, and the other end carries a grooved wheel about 7 in. in diameter driven from the motor spindle through a leather belt. At one side of this grooved wheel, and attached to it, is a small pulley covered with rubber. This small pulley is placed in contact with the rim of the wheel of the machine to be driven and this transmits the motion from the motor. This pulley is kept in contact with the rim of the wheel by aid of helical springs pressing against the end of the radial arm at the motor. The motor is provided with a large and convenient handle so as to facilitate carrying the machine about, while the starting switch is fixed to a projecting boss on the frame of the motor; a flexible cord with a suitable lamp-socket connector is wired to the switch.

The motor employed is of 1/7 hp liberally rated so that it can carry considerable overloads for short periods and is totally enclosed. Ball bearings are employed so as to obviate as far as possible the necessity for frequent lubrication. Its speed is about 1900 r.p.m., while that of the machines to be driven is about 60 r.p.m. At normal loads the consumption is said to be about 70 watts, but when running heavy machines, such as vacuum cleaners, the consumption rises to about 130 watts. The rectangular base of the motor is attached to a wooden baseboard by means of a double angle iron and an adjustable cam. A turn of this cam, one way or the other, instantly releases or as quickly fixes the motor to the baseboard.

In order to adapt domestic, hand-driven appliances for electric driving, special metal bosses are provided to fit over the existing spindles in place of the crank handle normally employed. The external dimensions of these bosses are made to a standard gage so that a cast-iron wheel, also supplied with every outfit, can be slipped over any of these bosses. The bosses when attached are never removed from the various appliances. Domestic appliances are usually provided with some form of clamping screw for attaching them to the table. As it is some trouble to tighten and loosen these screws, it is preferable to attach each machine permanently to a small piece of wood about 4 in. wide by 14 in. long which fits into auto-

matic spring clamps attached to the baseboard of the "Electric Mary Ann." Thus, to drive any machine that is so fixed, all that has to be done is to place it on the board with sufficient pressure to snap open the spring clamps, when it is held firmly in position for driving. For boot polishing or silver and plate

Figs. 3 and 4—Applications of Universal Motor.

cleaning, a flexible shaft is employed connected direct to the motor spindle by means of a special attachment. The free end of the shaft is provided with a swivel handle and is threaded to take brushes, buffs or mops, a number of which are supplied

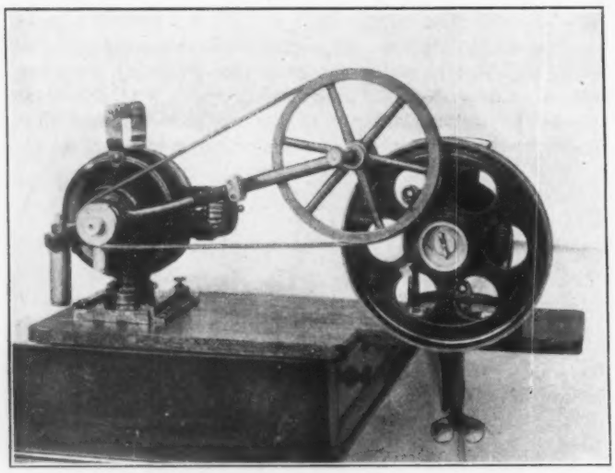


Fig. 5—Universal Motor Driving Coffee Grinder.

with the equipment for cleaning boots, or polishing silver and plate articles. The motor will drive any machine that is ordinarily turned by hand, and the list of such appliances is well over 50.

TURBO-ALTERNATORS.

The construction of turbo-alternators offers many mechanical difficulties due to the great strength required of all parts. The rotating member must withstand great centrifugal stresses and in event of short-circuit the stator winding is subjected to forces which exceed the normal torque by several thousand per cent.

A recent design brought out by the firm of Bruce, Peebles & Company, Ltd., Edinburgh, Scotland, is an interesting example of modern turbo-alternator construction. On the low-speed machines the stator frame is of the open type, while for high speeds it is of the closed type used with forced ventila-

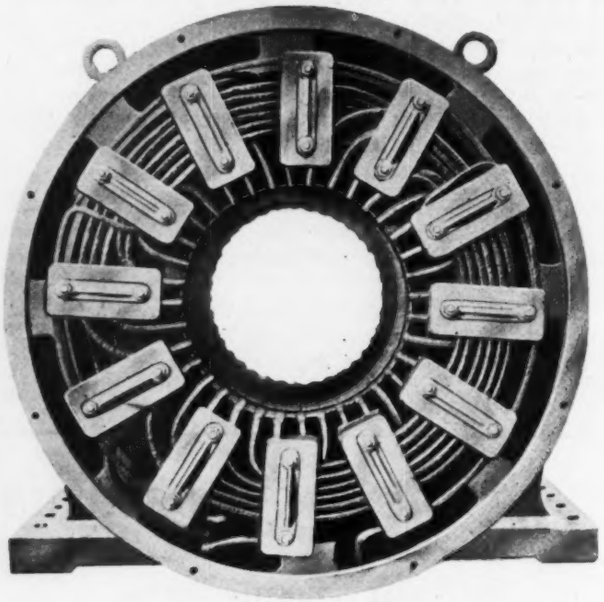


Fig. 1—View of Stator Showing End Winding Supports.

tion, provided either by fan blades on the rotor or by an external fan. Cast iron is the metal used. The stator core is made of sheet-steel punchings dovetailed to the frame with ventilating spaces at intervals between the laminations.

The stator winding is of wire, strip or bar, depending on the size and voltage of the machine; the slots in the core are lined with insulating tubes of such composition that ample mechanical strength is combined with the good insulating properties, and these tubes project well beyond each end of the core in order to avoid the possibility of breakdown at the points where

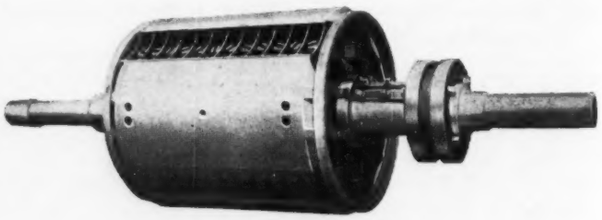


Fig. 2—Four-Pole Rotor.

the windings leave the slots. The ends of the windings are mechanically stayed against forces due to short-circuit currents by heavy gun-metal clamps held by bronze studs screwed into end plates and insulated from the winding by blocks and tubes of molded mica, as shown in Fig. 1. The rotors are made

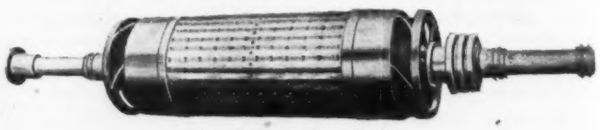


Fig. 3—Two-Pole Rotor.

both with projecting poles and of the cylindrical type. The cylindrical type is used on two-pole machines and the projecting poles on machines with four or more poles. Figs. 2 and 3 show these two types of rotors. The ventilating blades are plainly shown on the ends of the two-pole rotor in Fig. 3. The windings on the four-pole rotor (Fig. 2) are held in place by shields which fill the space between the poles.

Industrial and Commercial News

THE WEEK IN TRADE.

EXAGGERATION of damage to crops by storms is quite the usual thing, and the reports which followed the recent storms seem to have been no exception. Subsequent advices from the Mississippi Valley, and from the cotton regions of the South, indicate that the damage by the recent cold snap was not nearly so severe as was at first anticipated. This news has had a tendency to cheer up the discouragement felt by many business interests. The reaction, while not of any considerable extent, has brought about better business conditions during the past week, more orders for the wholesalers and jobbers and a better trade among the retailers. It has also improved the condition of the securities market, and altogether the situation is more satisfactory than it was at the end of the week previous. Reports from the industries vary widely. The building trade for April shows good gains over the earlier months of the season, but the inclement weather was something of a check to this line. Lumber and building materials, however, were fairly active, especially in the cities, in which construction work is going forward. In the textile industry there is a slightly better feeling in cotton goods, although the irregularity of the market for raw material is still a drawback. The woolen manufacturing trades show little improvement. In the iron and steel industry orders are fewer, but the mills are still reasonably busy and have a prospect of being fairly active during the summer. Pig iron is quiet, owing to overproduction, and 34 important furnaces have gone out of blast. Reports of collections show that they are irregular, and not as satisfactory as wholesalers could wish. Business failures for the week ended May 5, as reported by *Bradstreet*, were 191 against 189 the previous week, 214 in 1909, 288 in 1908, 154 in 1907 and 162 in 1906.

THE COPPER MARKET.

COPPER prices were lower last week than at any time during the present year. While there has been some increase in the export business, the contracts being taken are mostly for future shipments and the new business is due entirely to the prevailing concessions in price. During the past week there was some increase in the domestic demand for electrolytic copper, and a few consumers were hunting bargains for large orders to be delivered in June and July. It is claimed that during the week electrolytic was sold as low as 12¼ to 12⅜ cents for cash, and 12½ cents for 30 days. It is also said that casting copper sold as low as 12 cents for June shipment. The report of the Copper Producers' Association for April showed an increase in the surplus stock of copper of 18,159,285 lb. The total production for the month was 117,477,639 lb., as compared with 120,067,467 lb. in March. The daily rate of production in April was, however, greater than that of the previous month, being 3,915,921 lb., as compared with 3,873,144 lb., an increase of 42,777 lb. The domestic deliveries in April were 67,985,951 lb., an increase of 5,141,133 lb. over the previous month, but the exports were only 31,332,403 lb., a decrease of 9,253,364 lb. The total stock of copper in the country on May 1 was 141,984,159 lb., almost exactly the same amount as was on hand as surplus on the first day of the year. The market was little affected by the statement, as the figures were pretty well known in advance. L. C. Graton, secretary of the Copper Producers Association, declares that the monthly statements will be continued, and that the rumor that the Amalgamated interests had tried to have the publication of these figures stopped was entirely untrue. He said there was no opposition in any quarter to making the figures public. Exports of copper for the month, including May 9, were 4,003 tons. On the Metal Exchange May 9 standard copper was quoted as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling price.
Spot	12.05	12.30	.....
May	12.05	12.30	12.17½
June	12.05	12.30	12.17½
July	12.05	12.35	12.20

The London market May 9 was as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	55	15	0	55	12	6
Standard copper, futures	56	13	9	56	12	6

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c			12.05c		
London, spot	£62	0	0	£55	2	6
London, futures	65	18	9	56	2	6
Best selected	65	10	0	59	10	0

INDUSTRIAL AND COMMERCIAL NOTES.

Consolidation of Rubber Manufacturing Concerns.—The consolidation is announced of the Massachusetts Chemical Company, the Walpole Varnish Works, the Walpole Shoe Supply Works, all of Walpole, Mass.; the Valveless Innertube Company, of New York City, and the Walpole Rubber Company, of Granby, Quebec. The new company formed by the consolidation will be known as the Walpole Rubber Company, and the entire property will be managed by practically the same men who have been so successfully operating the Massachusetts Chemical Co. The factories are located in Walpole and Boston, Mass., and in Granby, Quebec, with branches in New York, Chicago and London. The new company will control the Gleason fusible core process and other patents of F. J. Gleason, second vice-president, which were formerly controlled by the Walpole Rubber Company. Other products manufactured by the combined companies include insulating varnishes and friction tapes for electric manufacturing and operating companies, molded mechanical rubber goods, soling, matting, box toe shellac, backing and gem cloth and other specialties for shoe manufacturers, rubber heels and soles, etc. The combination was effected, it is stated, in order to give increased opportunities for economical manufacturing and selling. At Walpole work has already been started on a new building with about 100,000 sq. ft. of floor area, located on a tract of about 50 acres, owned by the company, abutting on the Wrentham branch of the New York, New Haven & Hartford Railroad. The Neponset River, flowing through it, has two waterfalls with drops of 20 and 23 ft. This building will be completed about August 1 and will be used to increase the rubber reclamation plant, and to add extensively to the output of automobile tires, hot water bottles and syringes and to relieve the friction and rubber tape departments, which at present are running twenty-three hours per day.

General Electric Offices in Chicago.—The extent of the business transacted through the Chicago offices of the General Electric Company may be judged from the fact that it has become necessary to use all the space on the tenth floor of the large Monadnock Building for these offices. In 1894 the offices were established at the south end of this floor, with about 4000 sq. ft. of floor space. This space has been steadily and gradually extended until now the company occupies the whole floor, with 18,000 sq. ft. of floor space. The arrangement of the rooms and corridors has been changed to meet the company's requirements. J. W. Johnson is manager of the Chicago office of this company.

Pennsylvania Power Company in Baltimore.—Electric power will be introduced into Baltimore from the Susquehanna River by the Pennsylvania Water & Power Company, the concern which took over the old McCall Ferry property, about Sept. 1. H. Homer, the local attorney for the company, says that the company is completing plans for bringing the energy from the McCall Ferry plant to Baltimore, and that he is practically sure it will be there in the time specified. The company is now building a distributing station on property purchased some months ago on the Philadelphia Road, just east of the city limits. This building will be equipped with the latest appliances and will be finished within two months. The distributing station is being built and equipped by the Susquehanna Transit Company.

Subway to Staten Island.—A charter was obtained in Albany last week for the incorporation of the Staten Island & Bayonne Subway & Development Company of Richmond Borough, New York. The nominal capital is $10,000, and among the directors are Charles E. Griffith, Edward P. Doyle, William Van Clief and Frank Foggin, of Port Richmond. It is planned to lay out a rapid transit route from Port Richmond to Tottenville.

Electrical Competition in Rio de Janeiro.—An injunction has been granted in Rio de Janeiro, restraining the Companhia Brazileira de Energia Electrica from proceeding to exercise the franchise recently granted it by the government, giving it the right to sell energy in the city and to use the streets for its transmission lines. The injunction was secured by the Rio de Janeiro Tramway, Light & Power Company, which claims the exclusive concession for the city. The new company was organized, and its hydroelectric plant on the Piabana River built, by Guinle & Company, the Brazilian representatives of the General Electric Company. The plant was completed last fall and the company is delivering energy in Nichtheroy at the present time, but the transmission lines into Rio de Janeiro have not yet been completed. Carlos Guinle, representative of the firm in this country, said with regard to this litigation that he had been advised from Brazil that it would not interfere with the work of building the transmission line into Rio de Janeiro, which will be finished in a few months. The distance from the plant to Rio is about 95 kilometers. Mr. Guinle says that the government has given his company a contract to furnish energy to the navy and certain other official departments from its hydroelectric plant and that it has also been given the right to sell energy, commercially, from steam plants which it proposes to build in the near future. He says that the company will not have the privilege of selling hydroelectric energy in Rio de Janeiro until 1915, on account of the terms of the existing concessions.

Canadian Pacific Tunnel in Ottawa.—The Canadian Pacific Railway Company has filed plans involving an outlay of about $1,000,000 for an underground line through the city of Ottawa, connecting the central station, near the foot of the Rideau canal, with the company's union station in the northwestern part of the city. The connection between the two stations is now made by a roundabout line across the Ottawa river and the outskirts of Hull. The proposed new line will enable all trains to be run by the shortest possible route between the two stations right into the center of the city, and will cut off several miles of the through line from Montreal to the west. The company proposes to acquire from the Dominion Government the bed of the Rideau canal from the "deep cut" to Sapper's bridge, a distance of half a mile, and, after diverting the water in the canal to the Rideau river, to run its railway line along the course of the waterway. It is proposed to construct an underground tunnel from near the post office to a point on Wellington street and thence on the street level to a connection with the present lines at the union station. The proposals will first have to be submitted to the Dominion Government and city council for approval. The development will make a radical change in the present railway facilities of the city. It is hardly likely, however, that the Government will consent to the proposed diversion of the Rideau canal, but that some compromise scheme will be adopted.

Train Dispatching by Wireless.—The Union Pacific Railroad has issued orders to immediately install wireless telegraph apparatus on the main lines of that system, and has announced that as soon as the installation is completed all trains will be dispatched by wireless. The system to be used is that of Dr. Frederick H. Millener, of Omaha, who has been experimenting for the past three years with wireless in the Union Pacific. Sending stations will be located at all division points, and receiving stations at every high point, as well as on all trains. Train orders will be sent to stations, as well as directly to moving trains. The master station at Omaha is almost completed.

Excess Indicator Company.—The Excess Indicator Company has made an arrangement whereby the Excess Indicator will hereafter be manufactured in Pittsburgh. The arrangement also provides for marketing the device on a large scale throughout this country and Canada. This device enables flat central-station rates to be controlled, and has been used successfully at Hartford and elsewhere in the East.

Turin International Industrial Exposition.—An international industrial exhibition will be held in Turin, Italy, April to October, 1911. An office in the interest of the exposition has been opened at 41 Union Square, New York, with the name, International Exposition Bureau.

Allis-Chalmers Company's Orders.—The Northern California Power Company has placed an order with the Allis-Chalmers Company covering the hydraulic turbine machinery, including all electrical machinery, for its new plant on Battle Creek, Shasta County, Cal. The order consists of three hydroelectric units of 7000 hp each, which include three 7000-hp single horizontal hydraulic turbines, three 5000-kw generators and two 250-hp single-phase exciter turbines. Another important order received by the Allis-Chalmers Company was from the Toledo Railways & Light Company for one 6800-hp steam turbine. Of this type of turbine the company within the past three months has completed and delivered 48 engines ranging in size from 400 hp to 3000 hp. The April bookings of the company were 40 per cent better than for the same month in 1909.

Electric Development at Ironwood, Mich.—F. D. Sullivan and associates, identified with the Ashland Power Company of Ironwood, Mich., have applied to the municipal authorities of that city for franchises for an electric light and power plant and an interurban railway. The Ashland Power Company recently took over the property of the Gogebic Electric Light Company of Bessemer. It will build a hydroelectric plant at Brownstone Falls, Mich., where a head of 135 ft. can be obtained. The installation will consist of two 1000-kw units and a high-tension transmission line. The plant will be operated in connection with the White River hydroelectric development. The interurban line will extend along the Gogebic iron range, serving various mining towns.

United Wireless in England.—C. C. Galbraith, general manager of the United Wireless Telegraph Company, returned from Europe last week, and said that he had arranged with the British postal authorities to have United Wireless messages from liners at sea admitted through the government land stations. He also said that quite a number of trawlers in the North Sea have been equipped with the United Wireless company's apparatus, and that fishermen found this service extremely useful in enabling them to keep in touch with the market and preventing overstocking. The Admiral boats of the fleet go out with the latest news and get in touch with the trawlers by wireless; if there is too much fish in the market captains are told to remain out.

Marconi Wireless Message Rates.—It has been announced in London that the Marconi transatlantic wireless telegraph rates have been placed on a basis of 15 cents a word for private messages. This announcement has created a considerable amount of interest among those lines of business which carry on daily cable communication with this country. The service between Glace Bay and Clifden, Ireland, was resumed on April 23. The rates to Eastern Canada will be 15 cents a word, and to all distant places 9 cents a word less than the existing cable rates. The capacity of the Glace Bay station has been greatly increased, and it is estimated that it will be able to handle at least 30,000 words a day.

Electric Furnace for Crucible Steel Company.—The Crucible Steel Company, of Pittsburgh, has awarded a contract for the construction of a Heroult electric steel furnace for the Park Steel Company works. This furnace is in reality an electric open hearth furnace, with electric heat instead of natural gas. It is said that by feeding this furnace with molten Bessemer steel direct from converters, that during an ordinary heat of about one and a quarter hours steel of the most ordinary quality becomes equal in texture to the finest crucible tool steels. The cost of production by this method is said to be very much less. The new furnace is to have a capacity of about 60 tons a day.

Advertisements for Power House Equipment.—The National Transcontinental Railway Commissioners, P. E. Ryan, secretary, are advertising for tenders until May 25 for the necessary equipment for the railway power house to be constructed east of Winnipeg, containing boilers, heaters, feedwater heaters, engines, generators, air compressors, pumps, etc.

Financial.

The Week in Wall Street.

WHEN it became known in the Wall Street market last week that our bankers were engaged in negotiations with European banking institutions which might lead to the placement of $100,000,000 of American securities in the foreign market, there was an immediate revival of interest in trading, and prices recovered the greater part of the losses which had been sustained during the ten days previous. This upward movement and optimistic tone continued until the announcement of the death of King Edward created a check. Many people are of the opinion that England, at least, will be

conservative in its investments in foreign securities until after the temperament of the new ruler is more thoroughly understood. It is felt by many that the death of the King at this time will create a political crisis, during which investors will take few risks. Conditions in this country have been distinctly improved, and the entire tone of the stock market has been better. It is now thoroughly understood that a decision in the two important corporation cases pending in the United States Supreme Court is unlikely before late in the fall. The money market is still in a very satisfactory condition, although rates are a trifle higher than they were earlier in the spring. The demand for bonds, however, is little improved, and many important issues are being held up waiting for a better market. The banks are liberal enough with all legitimate customers, and rates are not oppressive. Quotations May 9 were: Call, 3¾ per cent; 90 days 4 to 4¼ per cent. The quotations in the table are those of the close May 9.

NEW YORK.

	May 2	May 9	Shares sold.		May 2	May 9.	Shares sold.
All.-Ch.	10	9⅞	600	Int.-Met., pfd.	51¾	55½	33,100
All.-Ch. pfd..	33½	35	400	Mackay Cos..	88⅞*	86*	100
Amal. Cop...	65⅝	67⅞	382,820	Mackay C., p.	76½	75¾*	292
Am. D. T...	20½*	20½*	——	Man. Elev...	132	135½	625
Am. Loc.....	46¼	49¾	7,900	Met. St. Ry..	15*	15*	——
Am. Loc.,pfd.	110*	110*	——	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	75*	75*	——	Steel, com...	79¼	82¾	984,790
Am. T. & T..	133½	135⅜	10,202	Steel, pfd....	117	118	19,060
B. R. T.....	75¾	78¾	75,220	W. U. T....	67	68	2,900
Gen. Elec....	146	147½	4,900	West'h., com.	62	63½	4,400
Int.-Met.,com.	19½	21	31,100	West'h., pfd..	125*	110*	200

PHILADELPHIA.

	May 2.	May 9.		May 2.	May 9.
Am. Rys.....	45*	45	Phila. Elec.....	15	15⅛
Elec. Co. of A.....	12*	11⅞*	Phila. R. T.....	15⅝	18⅛
Elec. St. B'ty.....	58¼	58½	Phila. Trac.....	85	85*
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	44⅞	47⅝

CHICAGO.

	May 2.	May 9.		May 2.	May 9.
Chi. City Ry.....	180*	180*	Chi. Tel. Co.....	120	119
Chi. Rs., Ser. 1....	99*	99*	Met. El., com.....	17*	16*
Chi. Rs., Ser. 2....	28	28¼	Met. El., pfd.....	55	57¼
Com. Edison.....	113¾	113	Nat'l Carbon.....	109	108¾
Chi. Subways.....	2½	2½	Nat'l Car., pfd.....	119*	119*

BOSTON.

	May 2.	May 9.		May 2.	May 9.
Am. T. & T.....	133¼	135⅛	Mex. Tel.....	5⅝	6½
Cum. Tel.....	147	145*	Mex. Tel., pfd.....	6½	6¼
Edison E., Ill.....	249¼	249	N. E. Tel.....	133½	133
Gen. Elec.....	145¾	147	W. T. & T.....	15½	15½*
Mass. E. Ry.....	17	18	W. T. & T., pfd...	85*	86
Mass. E. R., pfd....	87	85½			

* Last price quoted.
Shares sold for week of May 2 to May 7.

FINANCIAL NOTES.

Chicago Elevated Merger Terms.—Unofficial reports concerning the tentative terms being discussed in connection with the proposed elevated railway merger in Chicago are to the effect that the West Side Metropolitan Elevated has been offered in cash about 70 per cent for the preferred and 25 per cent for the common stock. Some of the directors are said to be inclined to hold out for 80 for the preferred and 30 for the common. The South Side Elevated stockholders, it is said, have been offered 70 for their stock and have asked about 80. These are cash figures. The Northwestern Elevated is somewhat complicated by the ownership by the Union Elevated, and the offer for this has not been made public. The stock offers, it is understood, are par in new securities for both the Metropolitan preferred and South Side Elevated stock. It is announced that the total issue of securities to be offered in exchange for present stocks will be no greater than amounts now outstanding, so that if the share holders elect to take new stocks, they will get the future earnings of the property in the same ratio that current earnings are shown by the several companies.

Charleston (S. C.) Electric Properties.—The Charleston Consolidated Railway & Light Company has been incorporated in South Carolina with an authorized capital of $2,000,000, consisting of $500,000 of 6 per cent preferred, and $1,500,000 of common. It is expected that the preferred will ultimately be increased to $1,500,000, making the capitalization of the company $3,000,000. The new company has been organized for the purpose of leasing for 99 years the property and franchises of the present Charleston Consolidated Railway, Gas & Electric Company, and it will guarantee dividends on its stock. The old company will issue $500,000 of 6 per cent preferred stock, which it will sell at par to the new company, using the proceeds to provide for extensions and betterments. The local interests heretofore identified with the company will remain as at present, but a considerable amount of new capital is expected from the outside.

Michigan United Railways in Detroit.—Application has been made by the Michigan United Railways Company for a thirty-year franchise to operate cars in the streets of Detroit. The Michigan United, with headquarters at Lansing, operates about 200 miles of urban and interurban lines in the State of Michigan, but it never has yet reached Detroit. It is claimed that the entrance to the city will have no effect upon the present fight between the Detroit United Railway Company and the city authorities over the renewal of franchises. The Michigan United promises to sell eight tickets for a quarter, good at all hours for city transportation, as a concession for the urban franchise. The investment of the Michigan United as it now stands represents about $12,000,000, and the Detroit extension will cost about $2,500,000.

Detroit United Railway.—The report of the Detroit United Railway Company for the first quarter of 1910 shows gross earnings of $1,992,803, a gain of 19.4 per cent over the previous year. The expenses showed an increase of 21 per cent. Since 1907 the company has paid no dividends, and none are likely to be paid until the appraisal of the property has been decided by the Board of Arbitration, and until the questions of fares and franchises have been finally and definitely settled. The Board of Arbitration was to have begun its hearings on April 25, but an indefinite postponement was caused by the refusal of the engineer who appraised the property for the city to appear and testify.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Francis, Okla.; Glendale, Col.; Anniston, Ala.; Montezuma, Ga.; Crawfordsville, Ind.; Chihuahua, Mex.; Encarnacion, Mex.; Elizabethtown, Tenn.; Waldron, Ark.; Sylvania, Ga.; Albany, Ky.; Camrose, Alta., Can.; Stratford, Ont., Can.; Grand Forks, N. D.; Palmyra, Mo.; Guthrie, Okla.; Portland, Me.; South Sharon, Pa.; La Porte, Tex.; Ottawa, Ont., Can.; Cananea, Mex.; Holmesville, Tex., and Mulberry, Fla.

New York Telephone Company's Stock Increase.—A certificate was filed with the Secretary of State at Albany last week increasing the capital stock of the New York Telephone Company from $100,000,000 to $125,000,000. Of the existing capitalization there has been issued $85,672,800. Ford Huntington, treasurer of the company, certified that all of the stockholders consented to the increase. At the annual meeting of the stockholders the old board of directors was re-elected, and subsequently the old officers were also re-elected.

Deer River Power Company.—The Public Service Commission of the Second District of New York has authorized the Deer River Power Company, of Watertown, N. Y., to execute a mortgage upon its property for $200,000, to secure an issue of 6 per cent bonds. The company is authorized to issue at present $67,000 of the bonds at not less than 90, the proceeds to pay obligations incurred in developing the power.

Augusta & Aiken Railway.—It is said that the Seaboard Air Line is likely to come into possession of the Augusta (Ga.) & Aiken (S. C.) Railway Company, an electric line between these two cities. It is said that the plan of the Seaboard company is to build a road from Aiken to Columbia, S. C., and to use the tracks of the Augusta & Aiken in order to form a direct line from Augusta to Columbia.

Missouri & Kansas Telephone Company.—At a special stockholders' meeting of the Missouri & Kansas Telephone Company, April 28, it was unanimously voted to authorize an increase in the capital stock from $5,000,000 to $20,000,000. The company has recently been acquiring independent properties in Kansas and the adjacent territory.

North Georgia Electric Company.—The property of the North Georgia Electric Company, of Gainesville, Ga., was sold at auction last week to S. F. Smith, of York, Pa., for $400,000. The property included the Dunlap plant, transmission line to Atlanta and Tullulah Falls plant. The property will be taken over by the Georgia Power Company.

Berkshire Street Railway Company.—The Railroad Commissioners of Massachusetts have approved an increase of $300,000 in capital stock by the Berkshire Street Railway Company. The proceeds are to be used to pay for the property of the Pittsfield Street Railway Company, recently taken over.

Public Service Corporation of New Jersey.—A pamphlet which constitutes the first annual report of the Public Service Corporation of New Jersey for the year 1909 has just been given out. It shows gross earnings for the year $23,560,451, expenses and taxes $13,331,228, net earnings $13,229,222 and balance after paying all fixed charges and rentals $1,428,447. The corporation furnishes electric light and power to 146 municipalities, gas to 125 and railway service to 101. The total population served, according to the census of 1905 was 1,614,180. The total assets of the company are $61,912,449.

Northern Texas Electric Company.—Estabrook & Company and Parkinson & Burr, Boston banking firm, have purchased $1,100,000 of collateral trust, 5 per cent bonds of the Northern Texas Electric Company, and are now offering them to the public at 96 and interest, at which price they yield about 5.25 per cent. The Northern Texas Electric Company owns the entire stock of the Northern Texas Traction Company, which operates a railway line between Fort Worth and Dallas. The net earnings of the system for the year 1909 were $532,654, which is practically three times the interest charges on the entire funded debt.

Philadelphia & Suburban Railway.—The Philadelphia & Suburban Street Railway Company has formally laid before the councils of Philadelphia its plans for the construction of the Broad Street Subway, and the matter has been referred to the railway committee. The offer of the company provides that the city shall receive 10 per cent of the net receipts and that after July 1, 1960, the city shall have the right to purchase the road on the basis of the company's earning power, capitalized at 6 per cent. The company shall be exempt from payment of license fees on cars or apparatus of any kind.

United Railways Investment Company.—At the annual meeting of the United Railways Investment Company, of San Francisco, last week, the stockholders approved the plan to issue $6,000,000, 6 per cent 20-year bonds. These bonds are convertible into stock at par and are subject to redemption at 105 on any semi-annual interest date. The proposal to increase the capital stock of the company from $50,000,000 to $56,000,000 was also approved. This increase was made to provide for the conversion of the new bonds. The old directors were re-elected.

Chicago Telephone Company Stock.—Speaking of the recent decline in the price of the Chicago Telephone Company's stock, E. B. Sunny, president of the company, says: "There are two reasons for the drop from 135 to 120. One is the uncertainty in fixing the forthcoming rates, and the other is the fear of competition from the Automatic company. Our company cannot maintain first-class service, keep up its equipment, make required extensions and finance necessary stock or bond issues unless we pay 8 per cent dividends on the stock."

United Gas Improvement Company.—At the annual stockholders meeting of the United Gas Improvement Company, of Philadelphia, last week, the net profits of the company for 1909 were shown to be $6,656,109, equal to almost 12 per cent on the $55,520,700 capital stock. This profit is an increase of $329,401 over the previous year. Thomas Dolan was re-elected president of the company, and Samuel F. Bodine, Randal Morgan, Clement A. Griscom, Rudolph Ellis, William Wood and Morris L. Clothier were re-elected directors.

Telephones for Train Dispatching.—Contracts have been let for equipping the Santa Fe railroad system with telephone service for train dispatching between Albuquerque and Mojave. With the completion of this service, and the closing of a few gaps between Albuquerque and Newton, Kan., the Santa Fe will have superseded the telegraph with the telephone on the entire system between Chicago and the Pacific coast, save between Mojave and Bakersfield, where the tracks of the Southern Pacific are used.

United States Smelting, Refining & Mining Company.—The pamphlet report of the United States Smelting, Refining & Mining Company for 1909 shows large gains in earnings, in spite of the depression in the copper market. The net earnings for the year were $4,155,012, compared with $3,535,557 the previous year. The output of gold, silver, lead and copper was larger than the previous year, the increases being small except in the case of silver.

Shelby County (Ind.) Water, Gas & Electric Company.—Petry & Company, Chicago bankers, are offering to the public $250,000 of first mortgage 5 per cent bonds of the Shelby County Water, Gas & Electric Company. These bonds are offered at 102½. The proceeds are to be used for extensions and improvements.

Kansas City Electric Railway Terminal.—The Missouri & Kansas Terminal Building Company, with W. B. Strang as president, has been organized to build a $2,000,000 union electric railway station in that city.

DIVIDENDS.

American Brass Company, quarterly 1¼ per cent, extra ¼ per cent, payable May 2.

American Smelters Securities Company, quarterly preferred A 1½ per cent preferred B 1¼ per cent, both payable June 1.

General Electric Company, quarterly 1¼ per cent, payable June 1.

Northern Texas Electric Company, quarterly 1¼ per cent, payable June 1.

Pennsylvania Railroad Company, quarterly 1½ per cent, payable May 31.

Washington Railway & Electric Company, semi-annual preferred 2½ per cent, common 1 per cent, payable June 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Blackstone Valley Gas & Electric Company:					
March, 1910	$81,458	$39,708	$41,750	$24,105	$17,645
March, 1909	72,849	40,080	32,769	24,416	8,353
Cleveland, Painesville & Eastern Railroad Company:					
Quarter ended March 31, 1910	64,554	35,179	29,675	25,989	3,686
Quarter ended March 31, 1909	55,511	31,535	23,973	24,556	* 583
Cumberland Telephone & Telegraph Company:					
March, 1910	568,336	320,729	247,606	47,523	200,083
March, 1909	528,737	300,516	228,220	43,175	185,045
Dallas (Tex.) Electric Corporation:					
March, 1910	114,848	77,240	37,608	26,347	11,261
March, 1909	102,666	63,178	39,178	28,918	10,752
Galveston-Houston Electric Company:					
March, 1910	105,143	67,672	37,471	23,080	14,391
March, 1909	95,610	59,075	36,075	21,119	14,956
Illinois Traction Company:					
March, 1910	486,490	281,460	205,030	.....	.....
March, 1909	375,391	221,642	153,749	.....	.....
Lowell (Mass.) Electric Light Corporation:					
March, 1910	35,036	19,954	15,082	4,722	10,360
March, 1909	28,909	18,473	10,436	4,219	6,217
Manufacturers' Light & Heat Company:					
Quarter ended March 31, 1910	1,781,894	658,723	1,123,170	160,486	962,684
Quarter ended March 31, 1909	1,539,222	451,213	1,088,009	245,286	842,723
Minneapolis General Electric Company:					
March, 1910	103,966	41,568	62,398	31,426	30,972
March, 1909	89,039	40,428	48,611	30,135	18,476
Northern Ohio Traction & Light Company:					
March, 1910	173,423	99,158	74,265	43,291	30,974
March, 1909	150,684	86,720	63,964	43,803	20,161
Rio de Janeiro Tramway, Light & Power Company:					
March, 1910	631,336	350,160	281,176	.....	.....
March, 1909	599,615	380,033	219,582	.....	.....
Twin City Rapid Transit Company:					
March, 1910	598,402	304,774	293,628	140,229	153,399
March, 1909	541,936	279,307	262,629	138,963	123,666
United Gas Improvement Company:					
Year 1909	7,649,234	993,126	6,656,108	.....	.....
Year 1908	7,216,911	890,203	6,326,707	.....	.....
United States Smelting, Refining & Mining Company:					
Year 1909	.....	.....	4,155,012	1,018,652	3,136,360
Year 1908	.....	.....	3,535,557	517,609	3,017,947

* Deficit.

General News

Construction News.

ANNISTON, ALA.—Preparations are being made for enlarging the electric plant of the Anniston Electric & Gas Company, including the installation of an electrical generator. The company is erecting a high-tension transmission line between Anniston and Talladega. The company will also furnish electricity to towns and villages between the two cities. R. W. Mitchell is president of the company.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has been granted a franchise by the Ensley Council to construct an electric railway from Ensley to Corey, Ala.

GADSDEN, ALA.—Contracts will soon be placed by the Noccalula Railway, Light & Power Company for two miles of 50-lb. rails, trolley wire, insulators, etc. Louis Hart, of Gadsden, Ala., is interested in the company. H. A. Rogers, representing the Noccalula Railway, Light & Power Company, has been granted a franchise to construct and operate a railway in Gadsden. The proposed railway will connect Gadsden, Alabama City, Attalla and Lookout Mountain.

GURLEY, ALA.—A decision has been handed down by the chancery court making permanent the injunction of Williamson against the Gurley Electric Company, restraining the electric company from erecting a power plant in the residence section of Gurley. The injunction was secured on the grounds that the proposed plant would be a nuisance.

GLOBE, ARIZ.—It is reported that a movement is on foot for Thatcher, Pima, Safford and Solomonville to unite and build a joint electric plant to furnish electricity for lighting the four villages.

KOFA, ARIZ.—The Board of Supervisors has granted a franchise to C. F. Hall, of Kofa, to construct and operate a telephone, telegraph and electric system over any and all roads in Yuma County.

TEMPE, ARIZ.—Announcement has been made that a bill has been introduced in Congress authorizing the city of Tempe to issue bonds to the amount of $30,000 for the purpose of installing an electric light plant and also for $10,000 to build a city hall.

BENTON, ARK.—The Benton Light, Power & Ice Company is erecting a new power plant to provide for the increasing demand for electricity. The equipment of the plant will include a 75-kw, 2200-volt, 60-cycle, three-phase Westinghouse generator, driven by a 160-hp Westinghouse automatic compound engine. It is expected to have the plant completed by June 1, when a day service will be established.

HOT SPRINGS, ARK.—The Hot Springs Water Company is replacing its 120-hp steam driven pumping station, located on the Washita River, about two miles from Hot Springs, by a 150-hp, 200-volt, motor-driven triplex pump. The company is extending its transmission line from the electric power station to the pumping station. The steam plant will be moved to another site, four miles distant, and used as an auxiliary in case of low water.

SCRANTON, ARK.—Preparations are being made by the Scranton Telephone Company, recently organized, for the erection of about 35 miles of telephone line, connecting Clarksville, Scranton, Prairie View, Dublin, Brown and Paris.

WALDRON, ARK.—The city has engaged F. W. Gantt, of the Sequoyah Engineering Company, of Fort Smith, Ark., to prepare plans for a municipal electric light plant for Waldron.

WILSON, ARK.—Preparations are being made by Lee Wilson & Company for rebuilding their power plant, recently burned. It is understood that the initial equipment has been purchased, but more will be required later.

CHICO, CAL.—Plans are being prepared by the Northern Electric Railway Company for the erection of a power station at Lake Winola, at a cost of $30,000.

GLENDALE, CAL.—The Glendale & Eagle Rock Railway Company has petitioned the Board of Trustees for a franchise to extend its railway to the northern limits of the City of Glendale.

SACRAMENTO, CAL.—Application has been made to the Board of Supervisors by J. A. Shaw for a franchise to erect transmission lines over the public roads of the county to transmit electricity for lamps and motors.

SAN BERNARDINO, CAL.—The entire townsite of the new town Calzona, located in the western section of San Bernardino county, has been purchased by a syndicate headed by Spencer W. Hudson, president of the Pacific Tank & Steel Company. It is understood that the new owners propose to make immediate improvements to the place, including the installation of water and lighting plants.

SAN FRANCISCO, CAL.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until June 15, for alterations to United States custom house and appraisers' stores building in San Francisco, Cal., including the installation of a heating plant, electric wiring, etc., in accordance with drawings and specifications, copies of which may be obtained at the above office or at the office of the architects, Eames & Young, Wright Building, St. Louis, Mo. James Knox Taylor is supervising architect.

SAN RAFAEL, CAL.—Plans are being prepared by Frederick Butterfield and associates for the construction of a street railway from Corte Madera through Ross Valley towns and San Rafael to McNear Point.

CANON CITY, COL.—Orders have been placed by the Colorado Light & Power Company with the Allis-Chalmers Company, of Milwaukee, Wis., for an 1875-kva, 560-volt, three-phase, 30-cycle, low-pressure steam turbo-generator set. Steam from the present units will supply the new turbine.

DENVER, COL.—The Central Colorado Power Company is erecting transmission lines throughout the Boulder district, where many steam plants are being displaced by motor-driven machinery. The Good Luck Gold Mill, located in Boulder County, has recently installed 80 hp in electric motors, displacing its steam plant. It is reported that the Central Colorado Power Company will soon apply for a franchise to furnish electricity for lamps and motors in Denver. The company is operating a large plant at Shoshone, near Gleenwood Springs, and is supplying energy in Leadville and to a number of mines in the Breckenridge and Boulder district. It expects to have its plant at Boulder finished by the first of July, which will have an output of about 20,000 hp. Transmission lines have been erected from the Shoshone and Boulder plants to the large substation on the outskirts of Denver. For some time the company has been furnishing the Denver Gas & Electric Company power under contract.

GLENDALE, COL.—Plans have been approved for the installation of a large power plant at the Jaeger group of mines, located near Glendale. The plant will furnish power to operate the mines and driving of the Jaeger tunnel from the present breast at 350 ft. from the portal on Left Hand Creek to cut the several veins of the group at great depth. C. B. Hull is engineer.

GOLDEN, COL.—A franchise has been granted to R. C. Vidler to operate an electric railway from Golden to the foot of Lookout Mountain.

LOVELAND, COL.—The City Attorney is preparing ordinances regarding the grounding of secondaries. This action is the result of the recent reinspection of Loveland by the underwriters, their report showing the lighting conditions to be very much more defective than the average. The central station is now owned by the Northern Colorado Power Company, and conditions are being much improved.

PRIMOS, COL.—It is expected that the Primos tungsten mill will soon be placed in operation. The plant represents an investment of $150,000, and is equipped for electric motor drive, having a total motor rating of 120 hp. For the present the Central Colorado Power Company will furnish electricity for operating the mill, but the company expects soon to install its own plant.

COLCHESTER, CONN.—The stockholders of the Colchester Electric Company have authorized the sale of its property to interests identified with the T. M. Russell Engineering & Supply Company, of Middletown, Conn. The officers of the new company are: T. M. McDonough Russell, president; Charles R. Baker, secretary, and W. L. Whitney, treasurer and general manager, all of Middletown, Conn. The company will hereafter be operated from the office of the T. M. Russell Engineering & Supply Company, of Middletown, Conn.

DANIELSONVILLE, CONN.—The Danielsonville Cotton Company has decided to postpone the work on the reconstruction of a dam across the Quinebaug River in Killingly, indefinitely. The company had planned to establish a power plant at the dam and transmit electricity by means of high-tension wires to its mills in Danielsonville. Not being able to make satisfactory arrangements with owners of the land, it is said, has caused the company to abandon the project, and instead will install a 400-hp compound engine in its plant.

HARTFORD, CONN.—It is reported that the Hartford Electric Light Company has awarded contracts for construction of a new boiler house, 60 ft. x 75 ft., and an addition to the engine house, 60 ft. x 75 ft. The buildings to be of brick, steel and concrete.

WILTON, CONN.—The residents of Wilton are considering the question of lighting the streets of the town with electricity. It is reported that negotiations are being made with the Housatonic Light & Power Company to extend its service from Norwalk to Wilton.

WASHINGTON, D. C.—Bids will be received at the office of the Supervising Architect, Washington, D. C., until May 14, for furnishing and installing lighting fixtures in the post office, custom house and court house, in Cleveland, Ohio; post office and court house, at Grand Rapids, Mich., and the custom house in San Francisco, Cal., in accordance with plans and specifications, copies of which can be obtained at the above-named office. James Knox Taylor is supervising architect.

MILTON, FLA.—Bonds to the amount of $5,000 have been voted for the construction of a municipal electric light plant in Milton.

MULBERRY, FLA.—The Florida Mining Company, it is said, will install a complete steam turbine plant with a rating of 500 kw.

CAIRO, GA.—At an election held May 2 the citizens voted to issue $6,000 in bonds, the proceeds to be used for extensions to the municipal electric light system.

DUBLIN, GA.—The Pratt Engineering & Machinery Company, of Atlanta, Ga., has secured the contract for construction of an acid phosphate plant and furnishing machinery for the Consolidated Phosphate Company. The plant is to be equipped for electrical operation. I. Bashinski is president of the Consolidated Phosphate Company.

GAINESVILLE, GA.—The plant and holdings of the North Georgia Electric Company were sold at auction May 2 to S. F. Smith, of York, Pa., for $400,000. The property included the Dunlap plant, transmission line to Atlanta, and the Tullulah Falls property. The property, it is reported, will be taken over by the Georgia Power Company and entirely reorganized.

JACKSON, GA.—The Georgia Interurban Railway Company is reported to be contemplating the construction of an electric railway from Indian Springs to Jackson. A meeting of stockholders will be held May 16 to vote on the proposition to issue $50,000 in bonds to provide funds for the proposed road. Captain W. F. Smith, of Floville, Ga., is interested in the company.

MILLEDGEVILLE, GA.—A modern electric drying apparatus is being installed in the Milledgeville Brick Works. It is reported that other electrical improvements and additions may be made to the plant. J. W. McMillan is proprietor.

MONTEZUMA, GA.—The Montezuma Manufacturing Company is reported to be contemplating improving and enlarging its electric light plant.

PINEVIEW, GA.—Lorenzo Wilson, of Pineview, Ga., is reported to be in the market for equipment for a small electric light plant, including dynamo, wires, lamps and switchboard. The dynamo to be of sufficient rating to provide for 200 lamps or more, direct-current. Second-hand material preferred, if in good order.

ROME, GA.—Contracts have been placed by the Rome Railway & Light Company with the General Electric Company, of Schenectady, N. Y., for equipment of its power house, including a 500-kw turbine, one 300-kw rotary converter and auxiliary apparatus and a 250-hp boiler, to cost about $30,000.

STATESBORO, GA.—Arrangements are being made by the farmers on the public road between Statesboro and Groveland to erect a telephone line 12 miles in length to connect with the Statesboro line.

SYLVANIA, GA.—The citizens have voted in favor of the proposition to issue $40,000 in bonds, the proceeds to be used for the construction of an electric light plant, water works and sewer systems.

VALDOSTA, GA.—The Consolidated Ice & Power Company will soon commence work on the construction of a new light and power plant.

BLOOMINGTON, ILL.—The Bloomington, Pontiac & Joliet Electric Railway Company is reported to be building an extension between Pontiac and Chenoa. F. E. Parks, of Joliet, Ill., is manager.

CHICAGO, ILL.—The Sherwin-Williams Company, of Cleveland, Ohio, is reported to be contemplating the installation of alternating-current motors in its plant at Kensington, Chicago, Ill.

EDWARDSVILLE, ILL.—The power plant of the Sodemann Heat & Power Company is reported to have been secured by a syndicate headed by J. H. McLain, of Canton, Ohio. It is expected that the new company will take over the plant at once. The new owners, it is understood, will enlarge the plant in the east end of the city.

KEWANEE, ILL.—Plans are being made by the Home Telephone Company to install two miles of new cable to permit the installation of 600 additional telephones.

PRINCETON, ILL.—The Rock River Traction Company is reported to have awarded a contract for the construction of an interurban railway from Princeton to Rock Island, Ill.

BRISTOL, IND.—The Board of Trustees has granted the St. Joseph Valley Traction Company a franchise to construct and operate a railway in Bristol. It is proposed to extend the railway to Pioneer, Ohio, where it will connect with an electric road for Toledo.

CRAWFORDSVILLE, IND.—At an election to be held May 17 the proposition to issue $60,000 in bonds, the proceeds to be used for the construction of an electric light and power plant, will be submitted to a vote. There is already $40,000 available from the sinking fund, making the total cost of the plant $100,000. It is proposed to furnish electricity for industrial purposes as well as for street and commercial lighting.

DANA, IND.—It is reported that plans are being considered to double the output of the municipal electric light plant in Dana.

EVANSVILLE, IND.—The Burns Construction Company, of Chicago, Ill., is reported to be considering the construction of the proposed railway of the Evansville, Mt. Carmel & Olney Traction Company.

EVANSVILLE, IND.—The Board of Public Works has refused to grant a franchise to the Evansville Gas & Electric Company to construct and operate a central heating plant in Evansville.

EVANSVILLE, IND.—Plans are being prepared by the Evansville Railway Company for the construction of an extension of its railway from Boonville through Lynnville and the Pike County oil fields to Oakland City, Ind. F. M. Durbin, of Evansville, Ind., is general manager.

GOSHEN, IND.—Plans have been completed by the Home Telephone Company, of Fort Wayne, Ind., for the erection of a new toll line to Goshen, via Ligonier, to connect with South Bend toll lines for Chicago, Ill.

RICHMOND, IND.—The Commissioners of Wayne County have granted Robert M. Ashe a franchise to erect transmission lines on any and all of the highways in the county.

SOUTH BEND, IND.—Omer F. Neff, of Milford, Ind., has applied for a franchise to construct and operate a railway between South Bend and Bremen, Ind., the motive power to be either electricity or gasoline.

CEDAR RAPIDS, IA.—Application has been made to the City Council by William Dows and Isaac Smith for a franchise to construct and operate an electric railway in Cedar Rapids.

CHARLES CITY, IA.—The City Council has granted the Charles City & Western Railway Company a franchise to construct and operate an electric railway in Charles City. It is proposed to extend the railway to Marble Rock.

DAVENPORT, IA.—The Tri-City Railway Company, of Davenport, has been granted a franchise to extend its railway in Davenport. The company is contemplating extending its system to Muscatine, Ia.

IOWA CITY, IA.—The Randall Land & Improvement Company is preparing plans for the construction of an electric railway, work on which will begin within 60 days. Five miles will be built during the summer.

IOWA CITY, IA.—The Iowa City & Ottumwa Interurban Railway Company has awarded the contract for the construction of its proposed interurban railway from Iowa City to Ottumwa. Work will commence on construction of the road September 1 and is to be completed within two years. The company is capitalized at $3,000,000.

IOWA CITY, IA.—Contracts have been awarded by the Iowa City, Ottumwa & Southwestern Electric Railway Company for the construction of its proposed railway to August Steffin and Charles Kindt, of Davenport, Ia., and R. C. Campbell, of New York, N. Y. The railway will be 74 miles in length and will connect Iowa City and Ottumwa.

WEBSTER CITY, IA.—It is reported that plans are being considered to remove the municipal electric plant to another location. It is understood that new machinery will be installed.

WOODWARD, IA.—The question of constructing an electric railway from Woodward to the Phillips and Scandia mines is under consideration.

HUTCHINSON, KAN.—Preparations are being made by the United Water, Gas & Electric Company to increase the generating equipment of its plant. An order has recently been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for a 1000-kw, two-phase, 2200-volt, 60-cycle, 3600 r.p.m. steam turbo-alternator, which will be supplied with steam at 170 lb. pressure exhausting into a 28-in. vacuum.

SYLVIA, KAN.—James Roberts, of Sylvia, is reported to have purchased the local electric light plant.

ALBANY, KY.—S. G. Smith, E. Betram and Hancock Brothers are reported to be contemplating the construction of an electric light plant, for which a site has been purchased.

COVINGTON, KY.—The City Council has granted the Covington, Big Bone & Carrollton Railroad Company a 50-year franchise to construct and operate a railway in Covington. M. J. Crouch is interested in the enterprise.

FRANKFORT, KY.—The Central Kentucky Traction Company, recently organized, has submitted a proposition to the citizens of Frankfort, offering to construct an electric railway from Frankfort to Owenton, provided the rights of way can be secured from the property owners.

MONTVILLE, MAINE.—The Center Montville Telephone Company, recently organized with a capital stock of $5,000, proposes to construct and operate a telephone system through Liberty, Montville, Knox, Searsport, Belmont, Morrill, Waldo, Brooks and Belfast. James J. Clement, of Montville, Maine, is president of the company.

PORTLAND, MAINE.—The Portland Electric Company is reported to have purchased the property at Bonny Eagle and Limington Falls, owned by the Publishers' Paper Company. It is understood that the new owners will erect a large dam and power plant at Bonny Eagle to generate electricity, which will be transmitted to Portland to be utilized for illumination and manufacturing purposes. The Portland Electric Company is the holding company for the Consolidated Electric Company and Portland Electric Light & Power Company.

PORTLAND, MAINE.—Sealed proposals will be received by Captain C. F. Humphrey, Jr., constructing quartermaster, 655 Congress Street, Portland, Maine, until June 2 for constructing and remodeling an electric lighting system at Fort McKinley, Maine. Plans and specifications are on file in the office of the Chief Quartermaster, Department of the East, Governor's Island, New York, N. Y., and in the office of Constructing Quartermaster, 263 Summer Street, Boston, Mass. Plans and specifications may be obtained upon a deposit of $5 to guarantee return of same.

ROCKLAND, MAINE.—Announcement has been made by the Knox Telephone Company of its intention to lay a cable across the Penobscot Bay, from Owl's Head to North Haven, at a cost of about $25,000. It is expected to have the line in operation by June 1. S. M. Bird is manager of the company.

BALTIMORE, MD.—Samuel T. Williams, 223 North Calvert Street, Baltimore, Md., is reported to be in the market for two direct-current, 220-volt generators, belted; 50 to 75-kw, 125-volt, direct-connected set; one for 220 volts; also several 15-hp, 110-volt, direct-current motors, and two Corliss engines of from 75 to 125 hp each.

BALTIMORE, MD.—Plans are being considered by Mayor Mahool and Mr. McCuen, superintendent of lamps and lighting, for awarding contracts for lighting the court house and city hall. It is proposed to abandon the light and power plant in the court house and enter into a contract with the Consolidated Gas, Electric Light & Power Company for lighting both buildings at a rate of three cents per kw-hour. It is estimated that the city will save about $4,600 per year on the cost of lighting the buildings and $2,625 or more for heating.

ELKTON, MD.—Plans are being considered by the Elkton, Fair Hill & Oxford Electric Railway Company for the construction of an electric power plant.

BOSTON, MASS.—The Boston Elevated Railroad Company is planning to build a new power station at Green Street, Jamaica Plain, between Forest Hills and Egleston Square.

BROCKTON, MASS.—The Brockton Rand Company is equipping its factories, located at Montello, for electric motor drive throughout, replacing steam power. Electricity for operating the mills will be furnished by the Edison Electric Illuminating Company.

EAST BOSTON, MASS.—The Allis-Chalmers Company, of Milwaukee, Wis., which installed a 1500-kw steam turbo-generator set in the Maverick Mills the first of the year, has received an order for motors from the same company. The contract calls for 51 squirrel cage induction motors, varying in size from 20 hp to 100 hp and will be used for driving spinning machinery.

FOXBORO, MASS.—The local electric light plant, owned by the Foxboro Electric Company, has been purchased by parties interested in the Standard Gauge Company. It is understood that electricity for lighting the town will be furnished from the plant of the Standard Gauge Company and a 24-hour service established.

HAVERHILL, MASS.—The City Council is considering a proposition submitted by the National Meter Company, of New York, N. Y., to install an electric light plant for the city of Haverhill. The company offers to install a plant of sufficient size to supply electricity for 500 arc lamps of 500 watts each and 200 25-cp incandescent lamps, for $24,420. The equipment to include one 250-hp Nash producer gas engine, one 150-kw generator, one 250-hp producer, including foundations for engine, producer and generator; all piping, switchboard, conduits and conductors from switchboard to generator and power station. The company does not include in its estimates the land necessary for the station, lamps, pole lines or connecting the pole lines to switchboard. The cost of operating the plant, including interest, depreciation, etc., is estimated at $10,450 per year, making the cost for 300 lamps $34.43 each per year. The company offers to install a duplicate plant for $48,840, which would increase the cost of the lamps to $45.76 each per year.

LEXINGTON, MASS.—The Board of Gas and Electric Light Commissioners has authorized the Edison Electric Illuminating Company to purchase the plant and holdings of the Lexington Gas & Electric Company and to issue sufficient capital stock to pay for the same.

MILFORD, MASS.—Arrangements are being made by the Milford & Uxbridge Street Railway Company to install a new boiler in its power plant in Milford.

WESTFIELD, MASS.—The question of placing the wires of the municipal electric light plant underground is reported to be under consideration.

WINTHROP, MASS.—The Point Shirley Railway Company has been granted permission by the Selectmen to construct and operate an electric railway from Winthrop Beach Station to Taft Street.

CHARLOTTE, MICH.—The question of issuing bonds for the establishment of a municipal electric light plant in Charlotte is under consideration.

FLINT, MICH.—The Flint Electric Company has applied to the State Public Utilities Commission for permission to issue $100,000 in bonds, the proceeds to be used to take up outstanding debentures and for improvements to the plant.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company has received permission from the State Railroad Commission to increase its capital stock from $3,500,000 to $5,000,000 to provide for increased business.

IRONWOOD, MICH.—The City Council has granted an electric railway and an electric light franchise to Messrs. Sullivan and Appleyard in Ironwood.

IRONWOOD, MICH.—F. D. Sullivan and associates, who are identified with the Ashland Power Company, recently took over the property of the Gogebic Electric Company at Bessemer, Mich., and have applied to the City Council of Ironwood for franchises for an electric light and power plant and an interurban railway. It is also proposed to develop a water power at Brownstone at a head of 135 ft., installing two 1000-kw generators, work on which it is expected will begin in the near future. Besides a high-tension transmission line it is proposed to construct an electric interurban railway along the Gogebic iron range, serving Ironwood, Bessemer, Wakefield and the intermediate mining settlements. The Brownstone Falls power plant will be operated in connection with the White River hydroelectric power system. A company will be organized within a few weeks to carry out this project.

LANSING, MICH.—The North Lansing Power Company is reported to be contemplating the construction of a dam at North End during the coming summer. C. K. Madison is president.

OAKWOOD, MICH.—The Village Council has granted a franchise to the Edison Electric & Power Company to furnish electricity for lamps and motors in Oakwood. A special election will soon be called by the Council to submit the question of granting the franchise to a vote.

OTSEGO, MICH.—Plans are being prepared for the construction of an electric railway between Otsego and Kalamazoo, Mich. George E. Bardeen, president of the Mae-Sim Bar Paper Company, is reported to be interested in the project.

VAN BUREN, MICH.—The Fort Smith, Van Buren & Interurban Light & Traction Company will receive bids during the next 30 days for construction and equipment for an extension of its railway from Fort Smith to Van Buren, a distance of six miles. W. D. Pratt is president.

EAST GRAND FORKS, MINN.—The City Council has granted the Tri-State Telephone Company a 20-year franchise to operate its system in this city.

FAIRFAX, MINN.—The Crescent Milling Company, it is stated, contemplates the installation of 300-kw generator, gas engine and gas producer in its plant next fall.

MINNEAPOLIS, MINN.—The Electric Short Line Company is reported to have secured right of way from Minneapolis to Medicine Lake, Wayzata, Watertown and Winsted, and is now working toward Hutchinson and Litchfield for its proposed electric railway. It is said that the railway may ultimately extend as far as Watertown, S. D., by the way of Willmar and Ortonville. The company expects to have the road completed as far as Medicine Lake this summer. Earl D. Luce is president of the company.

VIRGINIA, MINN.—The Oliver Iron Mining Company is building a large power plant to furnish power for its Sauntry, Alpona and Enterprise mines.

MACON, MISS.—It is reported that plans are being considered by the City Council to enlarge and improve the municipal electric light plant and water works system.

KANSAS CITY, MO.—The stockholders of the Missouri & Kansas Telephone Company have authorized an increase in the capital stock of the company from $5,000,000 to $20,000,000.

MACON, MO.—Arrangements are being made by the South Dakota Interurban Company to resume work on the construction of its road, which was abandoned on account of snow. The railway will extend from Sioux City, Ia., to Pocatello, Idaho, a distance of 800 miles. It will be operated by electricity for the entire length. A large power house will be erected every 75 miles. Contracts for construction of the road have been let for a distance of 180 miles west of Sioux City, Ia. The cost of the road is estimated at $3,000,000. C. J. Dubois, of Macon, Mo., is chief engineer.

OSCEOLA, MO.—Utt Brothers and L. J. Highland, engineer, 108 La Salle Street, Chicago, Ill., are reported to be interested in a project to construct a steel and concrete dam across the Osage Run, at a cost of $25,000; the equipment to cost $25,000, and the installation of an auxiliary plant $50,000. It is proposed to develop 1000 hp.

PALMYRA, MO.—At an election held recently the citizens voted in favor of the proposition to issue $35,000 in bonds, the proceeds to be used to acquire or construct an electric light plant.

ST. LOUIS, MO.—The St. Louis & San Francisco Railroad Company is reported to be planning to install an electric light plant at Harvard, Ark. M. C. Byers, of St. Louis, Mo., is chief engineer of the company.

TIPTON, MO.—The City Council has ordered an election to be held May 24 to vote on the proposition to issue $17,500 in bonds, the proceeds to be used for the construction of a municipal electric light plant in Tipton. Joseph Sommerhauser is city clerk.

BUTTE, MONT.—The Anaconda Copper Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for 15 150-hp, three-phase, 2200-volt, 60-cycle squirrel cage motors. The motors will be used to operate plunger mine pumps, two motors being used for each pump. A single panel control board is to be supplied for each pump unit.

VIRGINIA CITY, MONT.—It is reported that the contract for the construction of the proposed electric railway to Alder has been awarded to Leber & Watson.

GRAND ISLAND, NEB.—The Railway Commission has authorized the Grand Island Telephone Company to increase its capital stock from $75,000 to $100,000.

HOLMESVILLE, NEB.—It is reported that plans are being considered by the Holmesville Mill & Power Company for the installation of an electric power plant with an output of 400 kw, consisting of two independent units.

OMAHA, NEB.—The Allis-Chalmers Company, of Milwaukee, Wis., has recently received an order from the Omaha & Council Bluffs Street Railway Company for a 3750-kva, three-phase, 13,200-volt, 25-cycle, 1500 r.p.m. steam turbo-generator, to be installed in the power house in Omaha.

CONCORD, N. H.—The Concord Electric Company has been awarded a contract for lighting the New Hampshire state prison with electricity.

LACONIA, N. H.—The Laconia Gas & Electric Lighting Company has been organized to take over the plants and holdings of the Laconia Electric Lighting Company and the Winnepesaukee Gas & Electric Company and also the construction of the plant at East Tilton, N. H. The officers are: William L. Mason, of Keene, N. H., president; Allen Hollis, of Concord, N. H., vice-president; George L. Rossman, of Keene, treasurer, and F. T. Brockingham, of Laconia, N. H., manager.

ANNANDALE, N. J.—The citizens are considering the question of establishing a municipal electric light plant.

PATERSON, N. J.—The East Jersey Pipe Company is reported to be contemplating the installation of a 125-hp direct-current electric generating unit, belted to a Corliss engine.

PATERSON, N. J.—The Board of Public Works has passed an ordinance requiring all overhead wires, with the exception of trolley wires, to be placed underground in the business section of the city before June, 1911.

PATERSON, N. J.—The North Jersey Rapid Transit Company has increased its capital stock from $1,000,000 to $2,000,000, and will soon authorize the execution of a mortgage to secure an issue of $2,000,000 in bonds. It is said that the directors are seriously considering an extension of the railway from Paterson down to Garfield, opposite Passaic City, and eventually beyond Suffern to Spring Valley, N. Y.

PAULSBORO, N. J.—At an election to be held June 7 the proposition to issue $7,000 in bonds, the proceeds to be used for improvements to light plant, will be submitted to a vote.

TRENTON, N. J.—The property and the holdings of the Trenton & New Brunswick Railroad Company were sold at public sale May 4 to the first mortgage bondholders for $200,000. The sale is a result of the financial troubles of the Camden & Trenton Railway Company, of which the New Brunswick line is a tributary.

FORT BAYARD, N. M.—Bids will be received by Lieut. Charles C. Winna, constructing quartermaster, until May 28 for furnishing and installing machinery for power, refrigerating and electric lighting systems at the above post. Further information furnished on application to the above office.

FULTON, N. Y.—The Common Council has passed an ordinance granting the Niagara-Ontario Power Company a 40-year franchise to distribute electricity over and under the streets of Fulton.

GASPORT, N. Y.—It is reported that the Town Board has decided to secure electricity from the Middleport electric light system for street and residential lighting in Gasport.

ISLIP, N. Y.—The Public Service Commission, Second District, has granted the application of the Islip Electric Light Company to exercise franchises granted by the villages of Islip and East Islip to furnish electricity in both villages for street and commercial lighting. The application was opposed by the Suffolk Gas & Electric Company, which is now serving gas in both villages.

NEW YORK, N. Y.—The New York Telephone Company has filed a certificate with the Secretary of State showing an increase in capital stock from $100,000,000 to $125,000,000. Of the existing capitalization there has been issued $85,672,800.

OLD FORGE, N. Y.—The Village Board has been authorized to make arrangements for lighting the streets of the village with electricity and enter into a contract for same.

OSWEGO, N. Y.—The Department of Water has decided to prepare preliminary plans for the construction of a power house, to be located on the Country Club site in connection with the dam that is to be built there.

RENSSELAER, N. Y.—The stret committee of Common Council has decided to recommend the substitution of tungsten lamps for the incandescent lamps now in use.

SYRACUSE, N. Y.—Plans are being considered by the Syracuse & South Bay Electric Railroad Company for extending its railway from North Syracuse to Cicero, Central Square and Brewerton, a distance of ten miles. H. C. Beatty is general manager.

VERMONTSVILLE, N. Y.—The Clinton County Telephone Company, recently organized, is planning to erect a telephone line from Vermontsville to Clayburg, via Merrillsville and Loon Lake. Lester Abbott, of Vermontsville, N. Y., is president.

ASHEVILLE, N. C.—The Asheville Telephone & Telegraph Company is erecting a long-distance telephone line to Waynesville, 28 miles in length, at a cost of about $10,000. It is said that the company proposes to build an extensive system of telephone lines radiating from Asheville to towns in the various sections of the mountains.

BESSEMER CITY, N. C.—The Osage Manufacturing Company is reported to be contemplating making extensions to its plant, which will involve an expenditure of about $75,000, and include the installation of additional carding machinery, looms, electric motors, etc.

CHARLOTTE, N. C.—It is reported that the second of the three auxiliary plants, recently ordered by the Southern Power Company, of Charlotte, N. C., will be located at Greensboro, N. C. The first is to be installed at Greenville, S. C.

DURHAM, N. C.—Surveys have been completed by the Southern Power Company for the erection of transmission lines from its hydroelectric plants to Durham; the wires to be placed on steel towers 55 ft. high. It is reported that an auxiliary plant will be erected.

RALEIGH, N. C.—A movement is on foot for the construction of an electric railway from Raleigh to Cary, seven miles in length. It is also proposed to establish a park about six miles out of Raleigh. The Carolina Power & Light Company is reported to be interested in the project.

BELFIELD, N. D.—The construction of an electric light plant in Belfield is reported to be under consideration.

GRAND FORKS, N. D.—The City Council has passed an ordinance providing $135,000 in bonds for improvements to municipal electric light plant, water works system and paving.

MOTT, N. D.—E. Rustard, of Grand Forks, N. D., is reported to have secured the contract to install an electric light system in Mott.

CLEVELAND, OHIO.—A contract has been awarded by the Cuyahoga Telephone Company for the construction of a branch exchange building in Cleveland.

COLUMBUS, OHIO.—The directors of the Cuyahoga Telephone Company have authorized the construction of a new branch exchange in Columbus at a cost of $30,000.

COLUMBUS JUNCTION, OHIO.—Investigations are being made by L. J. Highland, an engineer, representing a Chicago syndicate, with a view of locating a site on the Iowa River, where it is proposed to construct a dam and power plant.

COSHOCTON, OHIO.—The Coshocton Heat & Light Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 1600-hp, twin-horizontal open flume hydraulic turbine, direct connected to a 1000-kva, 4000-volt, three-phase, 60-cycle alternator. The turbine is designed to operate under a head of 32 ft. A 30-kw, 130-volt exciter will be belted to the turbine shaft.

MAUMEE, OHIO.—The Phoenix Light & Power Company, which is developing a water power near Maumee, is reported to have placed orders for equipment of its plant, consisting of two 26-in. twin hydraulic turbines, inclosed in plate steel cylindrical easings, designed to operate under a 61-ft. head; two direct connected, 937-kva, 2300-volt, three-phase, 60-cycle, alternating-current generators. A 450-kva generator, driven by a hydraulic turbine, has already been installed.

NELSONVILLE, OHIO.—Surveys have been completed for the extension of the Hocking-Sunday Creek Traction Company's railway to Athens. It is said that contracts for construction of the road will soon be awarded. It is understood that the company expects to extend the railway to Logan and there connect with an extension of the Scioto Valley Traction Company, which would give direct connection from Columbus throughout the Hocking Valley mining region. Charles Tutt, of Nelsonville, Ohio, is general manager.

TOLEDO, OHIO.—Plans have been completed by the Maumee Electric Company for the development of water privileges on the canal between Toledo and Grand Rapids. The plant located at Miami, which was the old plant of the Maumee Valley Electric Railroad, is almost completed. The company now proposes to commence work on its other plant to be located at Grand Rapids, where it will install a plant with an output of 1500 hp, giving it a total of 3500 hp. The company will not ask for a franchise in Toledo to distribute its power, all of which has been disposed for manufacturing purposes and will be transmitted over a private right-of-way. The Maumee Electric Company recently increased its capital stock from $100,000 to $350,000. James S. Ashley is president of the company.

COLLINSVILLE, OKLA.—Surveys have been completed for the proposed electric railway of the Cherokee Belt & Interurban Railway Company, extending from Pryor to Skiatook, a distance of 45 miles. Motor cars will be used for passenger service and steam locomotives for freight. Work on construction of the railway will begin within 90 days. Dr. E. Pleas, of Collinsville, Okla., is president and general manager.

FRANCIS, OKLA.—The Federal Utility Corporation, of Kansas City, Mo., is negotiating with the city in connection with the construction of an electric light plant, ice plant and water works system, to cost from $200,000 to $250,000.

GUTHRIE, OKLA.—Sealed proposals will be received by the State Board of Public Affairs, Guthrie, Okla., until May 16, for the erection of two cottages, power house, installation of heating, plumbing and electrical work for the Oklahoma State Home, at Pryor Creek, Okla., in accordance with plans and specifications as prepared by P. H. Weathers, architect, Guthrie, Okla. Bids will be received for the entire work and installation combined, and also on each item separately. Plans and specifications can be seen at the office of B. F. Lee, superintendent, Pryor Creek, Okla.; office of the State Board of Public Affairs, and at the office of the supervising architect of the State Board of Public Affairs, Guthrie, Okla. Proposals must be submitted on forms furnished by the supervising architect. T. A. Chandler, of Guthrie, Okla., is acting secretary.

HOBART, OKLA.—Preparations are being made by the Pioneer Telephone & Telegraph Company for the construction of an entire new telephone system, including the installation of new cables and switchboard. The central energy system will be installed.

BAKER CITY, ORE.—Announcement has been made by J. K. Ronig, manager of the Eagle River Light & Power Company, that his company expects to have its plant in operation about the middle of August and will be able to furnish electrical service in Baker City.

BEND, ORE.—Announcement has been made by Frank Robertson, of the Bend townsite committee, that the water system is to be enlarged and an electric lighting system installed.

HOOD RIVER, ORE.—Negotiations have been closed whereby the Hood River Light & Power Company has purchased the plant and holdings of the Hood River Electric Light, Water & Power Company for $115,000. John D. Wilcox, Wirt Minor and Robert Smith, of Portland, Ore., are interested in the new company.

KITTANNING, PA.—The Kittanning Telephone Company is contemplating making improvements to its system, which will involve an expenditure of about $10,000. It is proposed to replace the present plant with the central battery system.

LAWRENCEVILLE, PA.—The Crucible Steel Company has awarded a contract for the erection of a Heroult electrical steel furnace for the Park Steel Company's plant in Lawrenceville. The new furnace, it is said, will have a capacity of 60 tons per day.

LYKENS, PA.—The Schuylkill & Dauphin Traction Company has applied to the City Council for a franchise to build an extension of its railway to connect with the Pennsylvania Railroad in Lykens. W. E. Harrington is general manager.

NEW BLOOMFIELD, PA.—The capital stock of the Perry County Telephone Company has been increased from $60,000 to $200,000.

NEWPORT, PA.—Arrangements are being made by H. A. Romberger for increasing the output of his hosiery mill. It is proposed to build an addition to the present mill and a dye house. The equipment will include a 100-hp Corliss engine, two 100-hp horizontal boilers, two electric generators and two electric motors for direct current.

SOUTH SHARON, PA.—The Borough Council is considering the question of establishing a municipal electric light plant in South Sharon. It is estimated that a plant could be erected at a cost of about $50,000 and maintained for about $7,000 per year. The proposed plant would provide for about 100 street arc lamps and also for commercial and residential lighting. The cost of the street lamps if secured from a private company is estimated at $7,500 per year.

WOONSOCKET, R. I.—Arrangements are being made by H. K. Legace for the erection of a concrete block in Riverpoint. It is proposed to install an electric plant in the building.

CHARLESTON, S. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 11, for furnishing and installing piping, conduits, heaters, etc., in the yard and power plant at the navy yard, Charleston, S. C. Plans and specifications can be obtained on application to the above bureau or to the commandant of the navy yard named. R. C. Hollyday is chief of bureau.

GREENVILLE, S. C.—The citizens have voted unanimously to accept the proposition submitted by J. B. Duke and associates by which he agrees to furnish three-fourths of the capital to erect a $100,000 plant to furnish electricity to light the city. The remainder is to be raised in Greenville.

ABERDEEN, S. D.—The contract for installing lamps and electric wiring for three buildings at the Northern Normal and Industrial School, bids for which were opened May 3, has been awarded to the Hub City Heating & Plumbing Company, of Aberdeen, S. D.

ELIZABETHTOWN, TENN.—The Doe River Lighting & Power Company, which recently awarded a contract to the Lowe Construction Company, of Bristol, Tenn., for the construction of a dam at Horseshoe Bend, on Wautauga River, is in the market for machinery for its power house. The electrical equipment will include two 100-kw, three-phase, 60-cycle, 2300-volt generators, three step-up transformers to transform current from 2300 to either 22,000 or 33,000 volts, and three step-down transformers to change the voltage back to 2300 volts; switchboard complete, with instruments and copper wire, etc., for a 22-mile high-tension transmission line. The water-power machinery will consist of three turbines to operate under a 50-ft. head developing 1200 hp each, and two governors. The cost of the dam and power plant complete is estimated at $250,000. The company invites inspection of the property not later than May 15 and bids not later than June 1. J. H. Grayson is general manager of the Doe River Electric Company.

BRYAN, TEX.—Prof. J. C. Nagle, recently elected city engineer, it is said, will prepare plans for a new water and light plant and sewer system.

CLEBURNE, TEX.—The Gulf, Colorado & Santa Fe Railway Company is reported to be contemplating the erection of an electric power plant in Cleburne. F. Merritt is chief engineer.

CLEBURNE, TEX.—Daniel Hewett and associates are reported to be interested in a project to construct a street railway in Cleburne. Work will commence on construction of the road as soon as the citizens subscribe $30,000.

DALLAS, TEX.—The Texas Traction Company has decided to extend its railway to Waco. J. F. Strickland is president.

HOUSTON, TEX.—The Houston & Terminal Company is planning to install an electric interlocking plant in Houston, to cost about $10,000.

LA PORTE, TEX.—Plans are being considered by the Houston-Bay Shore Traction Company for the construction of power plant and car barn in La Porte. The power plant will have an output of 900 hp and will be operated by steam power. The cost of the plant is estimated at about $110,000. The company is also contemplating building a substation and passenger station in South Houston. J. G. Miller, of Houston, Tex., is engineer.

TEMPLE, TEX.—The question of building an electric interurban railway between Temple and Waco is under consideration. A committee has been appointed to arrange preliminary details. Right of way between the towns has been pledged and grounds for terminals donated. R. T. Gunn is interested in the project.

OGDEN, UTAH.—Arrangements are being made by the Ogden Rapid Transit Company for equipping the Plain City suburban railway for electrical operation, to be completed before the summer is over. At present a steam dummy propels the cars from Five Points to Plain City.

PROVO, UTAH.—Application has been made to the County Commissioners by A. J. Evans and S. L. Shipman for a franchise to build an interurban railway through Utah County. They have also applied to the City Council for a local franchise.

ENOSBURG FALLS, VT.—The Public Service Commission has authorized the Northern Telephone Company and the Citizens' Telephone Co. each to increase their capital stock by $25,000, and the Central Telephone Company an increase of $30,000, making the amount of capital stock for each company $50,000. C. L. Ovitt is manager of the three companies.

ELKTON, VA.—The Metallic Alloy Company is reported to have secured a contract for lighting the town of Elkton, Md. The company has a manganese plant, located about a mile from the town.

FRONT ROYAL, VA.—The Independent Mutual Telephone Company, recently incorporated with a capital stock of $5,000, is planning to construct a telephone line about 15 miles in length, connecting Strasburg, Middletown, Front Royal and Winchester. Lovell Hoffman, of Waterlick, Va., is engineer in charge of the work.

RICHMOND, VA.—The council committee on electricity has accepted plans presented by Samuel Cohen, J. G. Corley, representing the Retail Merchants' Association, for the illumination of Broad Street, from Pine Street to the city hall. The plan proposed calls for the erection of six ornamental posts carrying five tungsten lamps to each block. The cost of the initial installation is estimated at $26,500, and an annual cost of maintenance of $2,500, less the cost of arc lamps now in use.

SALTVILLE, VA.—A contract has been placed by the Nathieson Alkali Works with the Allis-Chalmers Company, of Milwaukee, Wis., for additional electric equipment for its plant, including two 75-kw, oil-filled, self-control, 2200-220-volt transformers; one 175-kw, 220-volt, two-phase 60-cycle, 225 r.p.m., engine type alternator, one 10-kw exciter unit and switchboard.

ACME, WASH.—Fred Zobrist has filed a petition with the Board of County Commissioners asking for an electric light and water franchise in Acme.

HOQUIAM, WASH.—The Grays Lumber Company, which is now equipping its plant for electric motor drive, has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for motors. The contract calls for two 50-hp, one 40-hp, one 20-hp, one 15-hp, one 10-hp and two 7½-hp, 440-volt, three-phase, 60-cycle, squirrel cage induction motors.

SNOHOMISH, WASH.—The Everett-Tacoma Railway Company will soon begin work on the construction of its proposed railway, 110 miles in length, to connect Everett, Snohomish, Monroe, Holt, Issaquah, Renton, Kent, Puyallup, Seattle and Tacoma. The company has recently filed a first mortgage with the county auditor to secure an issue of $5,000,000 in bonds. C. A. Barron, of Snohomish, is general manager.

WHEELING, W. VA.—The Wheeling Traction Company has awarded a contract to the Federal Engineering Company for the construction of an extension of its railway, including a tunnel.

ASHLAND, WIS.—Prof. D. W. Mead, of Madison, Wis., is reported to have been engaged by the Ashland Light, Power & Street Railway Company as consulting engineer for its proposed power development.

KAUKAUNA, WIS.—Arrangements are being made by the Kaukauna Telephone Company to erect several circuits in the rural districts to furnish telephone service among the farmers.

KENOSHA, WIS.—An agreement has been made between the Kenosha Gas & Electric Company and the Kenosha Home Telephone Company, which will result in the reconstruction of nearly all the overhead system in Kenosha. The companies will use all poles jointly.

CAMROSE, ALTA., CAN.—M. A. Maxwell, of Boston, Mass., is reported to have been engaged by the city to prepare plans for a municipal electric light plant. The plant will probably be located on Stony Creek, east of the Grand Trunk Railroad bridge.

FERNIE, B. C., CAN.—A by-law appropriating $6,000 for extensions to the electric light system will be submitted to the people.

CLINTON, ONT., CAN.—At an election held recently the citizens voted to grant the Clinton Electric Light Company a new contract.

OTTAWA, ONT., CAN.—Bids will be received until May 25 by the Commissioners of the Transcontinental Railway for equipment necessary for power house in connection with the shops east of Winnipeg, including water tube boilers, mechanical stokers, feed water heaters, engines, generators, air compressors and pumps. Plans and specifications may be seen in the office of Gordon Grant, chief engineer of the commissioners, Ottawa, Ont., and in the office of the district engineer of the

commissioners, at St. Boniface, Man., Can. Proposals must be made on printed form supplied by the commissioners, which may be secured at either of the above named offices. P. E. Ryan is secretary of the Commissioners of the Transcontinental Railway.

PORT ARTHUR, ONT., CAN.—Sealed proposals will be received by Adam Beck, chairman Hydro-Electric Power Commission, Continental Life Building, Toronto, Ont., Can., until May 25 for the construction of a transformer station building at Port Arthur, Ont., according to plans and specifications, which can be obtained at the above office. Separate tenders for structural steel work will receive consideration. A deposit of $5 will be required to guarantee return of plans.

STRATFORD, ONT., CAN.—It is reported that bids will soon be called for the construction of an electric distributing plant in Stratford, to cost about $75,000.

TORONTO, ONT., CAN.—Bids will be received until May 21 by the University of Toronto, Toronto, Can., for furnishing and installing heating and electrical equipment, constructing tunnels, etc., for the central heat, light and power plant. Plans and specifications for the entire work may be seen at the office of Griggs & Holbrook, 3 South William Street, New York, N. Y.

QUEBEC, QUE., CAN.—Preparations are being made by the Quebec Railway, Light, Heat & Power Company for the construction of an eight-story building on the Jacques Cartier Market site. The company also proposes to construct a double-track extension from Maple Avenue to the top of Sillery Hill, a distance of 2½ miles, work on which will soon commence. C. E. A. Carr is general manager.

CANANEA, SONORA, MEX.—The Cananea Consolidated Copper Company is contemplating the installation of two additional steam turbo-generators of 1500 kw each. The company may also purchase a number of motor-driven air compressors within the next few months.

CHIHUAHUA, MEX.—Preparations are being made by the Sierra Mining Company to install a hydroelectric power plant at its mines in this State. Application has been made to the Federal Government by Robert Linton, representing the company, for a concession to use the water of the Navosaigame River to operate the proposed plant.

CHIHUAHUA, MEX.—Ten concessions have been granted to the Mexican Securities Corporation, of Halifax, N. S., Can., by the State Government, under the terms of which the company agrees to establish electric lighting and power systems in the towns of Santa Barbara, Villa Escobedo and Zaragoza in the district of Hidalgo; Saucillo, San Francisco de Conchos, Rosales, Naica and Meoqui, in district of Camargo and Aldama and Sta. Eulalia, in the district of Iturbid. The Mexican Securities Company is said to be closely allied with the Mexican Northern Power Company, which is building a large dam and hydroelectric plant on the Conchos River, 17 miles from Santa Rosalia. It is understood that the last-named company will erect transmission lines to all the towns embraced in the concession granted to the Mexican Securities Corporation to provide electricity for the systems for the different towns.

ENCARNACION, HIDALGO, MEX.—Arrangements are being made by Robert S. Towne and associates, owners of the Flojonales copper mines, near Encarnacion, for the construction of an electric power plant on the Ismiquilpan River. The proposed plant will have an output of about 20,000 hp, and will furnish electricity to operate the mines and mills of the syndicate, and also to operate an electric railway, which Mr. Towne and associates are planning to build to Sayula, a station on the National Railways in Mexico.

Personal.

DR. BARTHOLOMEW J. SPENCE, formerly of Princeton University, has been made assistant professor of physics at the University of North Dakota.

MR. JOHN R. PRICE, instructor in electrical engineering at the University of Wisconsin, has been appointed assistant professor in the department.

MR. GEORGE POULTON, who has been connected with the Municipal Electric Light Plant at Nelson, B. C., has been appointed general manager of the Nelson Electric Tramway Company.

MR. C. H. HODSKINSON, of the Boston Edison Company, has been appointed master of transportation of the National Electric Light Association, in succession to the late Mr. Geo. F. Porter.

MR. ALBERT SPIES, formerly editor of *Cassier's Magazine* and later editor of the *Electrical Record,* has established a new technical journal, the *Foundry News,* of which the first number has just been issued.

MR. C. T. WILKINSON, of the power and mining engineering department of the General Electric Company, has left this country for a visit of several months to England and France for the purpose of investigating the high-tension transmission situation.

MR. S. E. SIMMONS, formerly assistant superintendent of transportation of the Georgia Railway & Electric Company, has been appointed superintendent of transportation, with headquarters in Atlanta, to succeed Mr. H. N. Hunt, who has resigned.

MR. R. H. GARRISON, contract agent for the Middlesex & Monmouth Electric Light, Heat & Power Company, Keyport, N. J., has resigned to become superintendent of the high-pressure gas plant, now building for the Atlantic Highland (N. J.) Gas Co.

MR. WALTER I. SLICHTER, who has been with the General Electric Company for the past 14 years and is now electrical engineer at the Schenectady office, has been appointed professor of electrical engineering at Columbia University, from which he graduated in 1896. Mr. Slichter has been a full member of the American Institute of Electrical Engineers since 1903.

MR. W. C. KALB has resigned as head of the brush-testing department of the National Carbon Company to accept the position of general superintendent of the reorganized Columbus Pneumatic Tool Company, recently incorporated as The Dunlap Engineering Company. Mr. Kalb, who is an electrical engineer, graduated from Ohio State University in 1904, has an extended acquaintance in the electric railway field.

MR. THEODORE STEVENS, of London, connected with the traffic department of the British Thomson-Houston Company, Ltd., is in this country investigating recent developments in heavy traction apparatus and in the electrification of railroads. Mr. Stevens is a native of this country and a graduate of Lehigh University. He has lived in England, however, for more than twenty years, and has become a British subject. This is his first visit to this country since he went abroad.

MR. J. R. McCOLL, who for the past five years has had charge of the engineering work of the heating and ventilating department of the American Blower Company, Detroit, will shortly leave that company to become a member of the engineering firm, Ammerman, McColl & Anderson, of Detroit, formerly Brush, Anderson & Ammerman. Mr. McColl did much consulting work along the lines of his future activity when a professor of engineering at the University of Tennessee and Purdue University.

MR. HUGO REISINGER.—Word has been received from Munich that the Prince Regent of Bavaria has decorated Mr. Hugo Reisinger, of New York, with the Star of the Commanders' Cross of the Order of St. Michael, in recognition of his successful work in promoting art exhibitions in Germany and the United States. Mr. Reisinger, who is one of the principal importers of lighting carbons in this country, was decorated last year with the Order of the Prussian Government. He is now in Europe. but was expected to sail for home May 10.

S. Z. DE FERRANTI, one of the great pioneers in the development of the electrical industry, has been nominated as president of the British Institution of Electrical Engineers. Mr. Ferranti turned his attention to electricity when a boy, and before he reached the age of sixteen had designed and built a dynamo which he sold for $25. His inventions in various lines are among the most notable contributions to electrical art. He was the first to advocate in Great Britain the transmission of electrical energy at a high voltage from a point where it could be produced cheaply to the place where it was needed. He advocated parallel operation while everyone else championed series, and met with severe criticism when in the early days he built an "enormous" 700-hp machine. In 1889 a 10,000-hp, 10,000-volt alternator of his design, which he also manufactured, was put in operation at Deptford, near London; though giving satisfactory service, it was later abandoned, owing to governmental action restricting the territory of the operating company. In connection with this installation he used cables for distribution at the voltage generated—10,000 volts—when it was freely predicted that only failure could result from such an undertaking. These were the first concentric cables, and as installed the outer conductor was grounded. Mr. Ferranti is a director of the firm known as Ferranti, Ltd., Hollinwood, Lancashire, England, and is a member of the American Institute of Electrical Engineers.

Obituary.

MR. WALTER CRAIG KERR.—It is with deep regret that we report the death of Mr. Walter C. Kerr, president of Westinghouse, Church, Kerr & Company, which occurred at Rochester, Minn., May 8. On March 1 Mr. Kerr went to Rochester for treatment by the Doctors Mayo, surgeons of international reputation, who found that an operation for cancer was imperative. The operation was successfully performed, convalescence was apparently rapid, but finally complications ensued which were the immediate cause of death. Mr. Kerr was actively engaged in the affairs of his company up to the moment of going West, and until a few days ago his friends and associates in the East, relying upon reports of his successful recovery, expected soon to welcome him home, and in condition for resuming his former active life.

MR. W. C. KERR.

Mr. Kerr was born at St. Peter, Minn., Nov. 8, 1858, the son of Rev. Aaron H. Kerr, a Presbyterian clergyman, who, as a chaplain during the Civil War, became widely known as Father Kerr. He received his primary education in the public schools of St. Peter,

and entered the mechanical engineering course at Cornell University, from which he was graduated in 1879. He remained at Ithaca as an instructor in Sibley College for a year, and assistant professor until 1883, when he resigned to join the Westinghouse Machine Company. From salesman he was promoted to manager of the company's New York office, and in 1884 became one of the organizers of the present firm of Westinghouse, Church, Kerr & Company, in which he first held the office of treasurer, later that of vice-president, and became president about fifteen years ago. At one time he was vice-president of the Westinghouse Machine Company, and at the time of his death was a director in the Electric Properties Company, and in the Lackawanna & Wyoming Valley Rapid Transit Co. Mr. Kerr was a trustee of Cornell University for the past twenty years, and always manifested the warmest interest in Sibley College, which is much indebted to him both as an adviser and as a liberal donor. He was a member of the American Institute of Electrical Engineers, American Society of Mechanical Engineers, Canadian Society of Civil Engineers, Franklin Institute, Lawyers' Club, Engineers' Club, New York Railroad Club, Psi Epsilon Club, Duquesne Club of Pittsburgh and the Richmond County Country Club. For some years he was much interested in yachting, and was an active member in the Seawanhaka Corinthian Yacht Club and the New York Yacht Club, serving on the regatta committees of both of these bodies. He held decided views as to the proper status of amateur yachting, and through his influence regatta meetings of these clubs became sporting events rather than mere social occasions. He was recently elected vice-president of the Merchants' Association of New York, and as chairman of one of its committees directed the preparation of its report on the solution of what is known as the west side railroad problem of Manhattan Island.

During his many years of activity Mr. Kerr conspicuously demonstrated in the administration of the business he built up that ethically sound business and professional principles are economically sound. He was a man of high ideals, and the type the business world is now beginning to recognize and demand. His temperament was such that he was beloved by all with whom he came in contact. His immediate friends are unable to measure the extent of the great loss that they have sustained through his death, and the members of the company of which he was president have lost their best friend. Many will remember his delightful conversational powers, which showed a well grounded and wonderful fund of information on the broad affairs of life, and an intimate knowledge of many special subjects. He was very active outside of business hours, either in public affairs relating to the general welfare, addresses to university students, preparation of technical papers, yachting activities or along some line of study and research. Among his favorite pursuits were the collection of precious stones, the study of certain plant and animal life, and plans for the improvement of educational methods. He had broad and elevated views as to the functions of technical journalism, as the editors who enjoyed his friendship can testify. His life work, however, was in connection with the engineering organization with which his name is associated. Early in his career he conceived the idea that engineering could be highly organized, and the masterly manner in which he developed the idea is evident from the statement that his company's present organization comprises, in round numbers, 500 office engineers, 700 engineers in the field and a total of 8000 men employed on various engineering works. From small beginnings his forceful personality and gift of organization were responsible for the development of Westinghouse, Church, Kerr & Co., and for its present commanding place among the engineering organizations of the world.

Mr. Kerr had resided for the past fourteen years at Dongan Hills, Staten Island, from which place the funeral services were conducted. He married, in 1884, Miss Lucy Lyon, daughter of County Judge and Surrogate Lyon of Tompkins County, N. Y., who survives him, with one son and three daughters.

Trade Publications.

FLEXIBLE CHAIN GEARING.—Typical examples of applications of the Morse chain to different classes of work are set forth in Bulletin 9 of the Morse Chain Company, of Ithaca, N. Y.

COMMON BATTERY TELEPHONES.—Different types of telephones for use on a common battery system are described in Pamphlet 29 of the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.

LAMP FIXTURES.—A line of fixtures and reflectors especially designed for the standard sizes of Mazda tungsten lamps is the subject of Bulletin 5 of the Benjamin Electric Manufacturing Company, Chicago, Ill.

BUSINESS NOTES.

THE REYNOLDS ELECTRIC FLASHER MANUFACTURING COMPANY has recently opened an Eastern office at 1123 Boradway, New York City, which is in charge of Mr. C. F. Ziegler.

ADREON MANUFACTURING COMPANY announces that its Chicago sales office has been moved to the McCormick Building, 193 Michigan Avenue, Chicago, Ill., from the Western Union Building.

THE EDWARD E. CARY COMPANY, importer of the "Fabius Henrion" lighting carbons and other electrical specialties, has removed its office from 59 Park Place to 30 Church Street, New York.

COSMOPOLITAN ELECTRIC COMPANY, one of the central-station companies in Chicago, has removed its offices to 150 Michigan Avenue. Mr. H. E. Niesz is the manager of this company.

ACHESON GRAPHITE BRANCH OFFICES.—The International Acheson Graphite Company has established branch offices as follows: New York, Room 511, West Street Building; Chicago, 457 Monadnock Block; Pittsburg, 309 Fourth Avenue.

THE UNITED STATES LIGHT & HEATING COMPANY, with general offices at 30 Church Street, New York, announces the removal of its Chicago office, on May 1, from Monadnock Building, to People's Gas Building, Michigan Avenue and Adams Street.

LOCKE INSULATORS.—The Locke Insulator Mfg. Co., Victor, N. Y., reports that the Southern Power Company after having had experience with both the one piece and two piece unit design for 100,000 volts, has just recently placed a very large contract with it for suspension insulators of the two-piece unit design for 100,000 volts. The judgment of this company that the better design for a suspension insulator unit is that made of two pieces of porcelain rests upon its experience as probably the largest user of suspension type insulators in the world.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 3, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

956,519. ELECTRODE FOR ARC LAMPS; G. M. Dyott, Pittsburg, Pa. App. filed April 28, 1906. For flaming arcs consisting of a block of iron with a plurality of end recesses and titanic material within the recesses.

956,530. ATTACHMENT FOR TELEPHONES; A. G. Howard, Holdrege, Neb. App. filed March 9, 1909. Built into the telephone casing for permitting parties to communicate without other parties listening in. Also a time-indicating dial to show the length of the time the wires are used.

956,543. DYNAMO ELECTRIC MACHINE; C. A. Psilander and T. S. Scott, Pittsburg, Pa. App. filed Feb. 6, 1906. Brush holder, the core structure having dovetailed projections and carried by a frame with recesses in which the brush holders are seated.

956,544. COMBINED ELECTRIC ARC OR RESISTANCE AND INDUCTION FURNACE; J. H. Reid, Newark, N. J. App. filed Feb. 3, 1909. An electric furnace with electrodes and a suspended induction coil adapted to be lowered into the charge within the furnace.

956,548. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; E. M. Tingley, Pittsburg, Pa. App. filed April 4, 1906. A box with supporting arms and ventilating passage, a carbon brush, and a direct-acting spring within the box insulated from the brush.

956,549. DYNAMO ELECTRIC MACHINES; E. M. Tingley, Pittsburg, Pa. App. filed Dec. 3, 1906. For spacing stiffening and ventilating adjacent coils of large size armature windings by means of short spacing blocks between the windings.

956,553. COIL SHIELD FOR DYNAMO ELECTRIC MACHINES; J. E. Webster, Pittsburg, Pa., and F. Duff, Allegheny, Pa. App. filed April 23, 1906. For field magnets of railway motors to protect them from mechanical injury, the shield having diagonally opposite edged portions bent partially around the coil leads to protect them.

956,554. DYNAMO ELECTRIC MACHINE; J. E. Webster and J. Le C. Davis, Pittsburg, Pa. App. filed March 9, 1908. Stationary field magnet in which the winding of an auxiliary or interpolar magnet is secured to the main frame, the frame being divided in two parts and hinge connected, and the interpolar windings being supported across the dividing plane of the field frame.

956,580. LOCK ALARM; J. F. Howard, Spokane, Wash. App. filed June 10, 1909. Sounds an alarm when the door is unlocked by means of a rack and pinion connected to the bolt work which controls an electric circuit and alarm.

956,603. ELECTRIC FIXTURE FITTING; E. C. Ruth, Mount Vernon, N. Y. App. filed Nov. 6, 1909. A base plate secured to the wall, a coupling secured to the fixture, and interlocking lugs carried by the parts.

956,604. ICE SEVERING DEVICE; G. F. Savoy, Pewaukee, Wis. App. filed May 3, 1909. Uses an electrically heated angular severing blade of high resistance.

956,666. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; C. B. Auel, Wilkinsburg, Pa. App. filed July 9, 1906. Brush holder consisting of a sheet metal box containing the brush, a socket clamp, a shaft, a spring coiled around the shaft and a pressure finger on and connected to the spring and the other bearing on the brush.

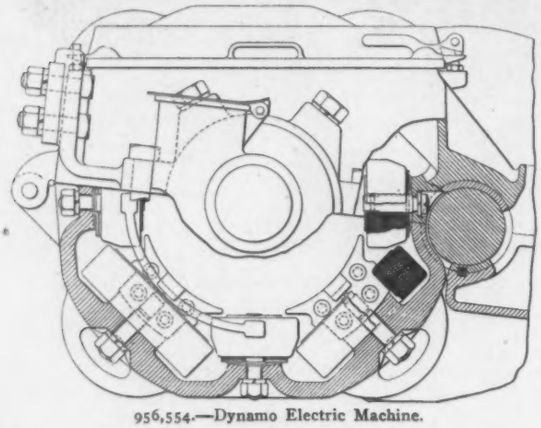
956,679. ELECTRIC SWITCH; J. H. Champ and T. H. Schutt, Cleveland, Ohio. App. filed Nov. 27, 1908. For controlling the valves of an air pump and for securing a quick make and break to avoid sparking. Details.

956,686. PHASE-SPLITTER; H. H. Cutler, Milwaukee, Wis. App. filed March 9, 1905. For starting single-phase induction motors in

which the field windings are connected in parallel pairs there being a separate resistance for each path and a common resistance together with a single movable member for adjusting the resistances.

956,699. CROWN OR COVER OF ELECTRIC FURNACES; P. Girod, Eugene, France. App. filed July 26, 1907. A frame of refractory material, a water-cooled mass of metal in the frame with electrode openings, the frame being surrounded by a metal band.

956,714. ELECTRICAL MEASURING INSTRUMENT; P. MacGahan, Wilkinsburg, Pa. App. filed Sept. 3, 1907. Two permanent bar



956,554.—Dynamo Electric Machine.

magnets of semi-annular contour and pole pieces separated therefrom with a movable coil threaded upon the pole member.

956,732. RACK RAIL LOCOMOTIVE; C. A. Pratt, Chicago, Ill. App. filed Jan. 28, 1907. Rack and pinion locomotive with a positive driving connection separate from the supporting wheels utilized to drive the motor as a dynamo down grade and for braking.

956,739. BRUSH HOLDER; R. Siegfried, Pittsburg, Pa. App. filed Nov. 3, 1906. Two side-by-side sheet metal pieces riveted together and spread apart at one end to form a box for the brush.

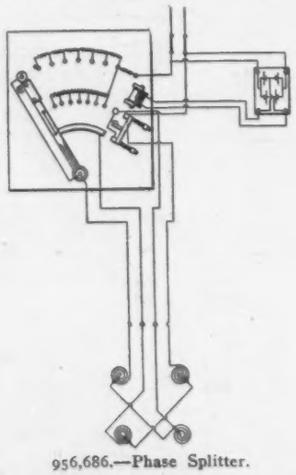
956,764. PROCESS OF PRODUCING LITHOGRAPHIC-PRINTING PLATES; W. Gerb, Berlin, Germany. App. filed May 4, 1909. Electrically deposits a layer of nickel on a cathode whose surface is grained and then separates the plate from the cathode.

956,782. SIGNALING SYSTEM; H. O. Rugh, Sandwich, Ill. App. filed Feb. 15, 1909. Selective signaling device for party-line telephones, the substation having a signal controlling element controlling two signals with switching devices at central to operate either signal, and to place the controlling element in operative position.

956,808. TELEGRAPHIC RELAY; I. Kitsee, Philadelphia, Pa. App. filed Jan. 27, 1908. A movable coil in a stationary field, one relaying contact suspended on a conducting thread, the other stationary with a battery applied to the contacts, a second circuit for the source of current and a translating device in the circuit.

956,815. ANNUNCIATOR; C. Miller, New York, N. Y. App. filed March 6, 1909. A frame carrying a magnet which attracts an armature having an arm acting as a stop and a shutter pivoted in the frame and engaged by the arm.

956,845. SINGLE-PHASE ALTERNATE CURRENT MOTOR AND GENERATOR; V. A. Fynn, London, England. App. filed Dec. 19, 1906. Single-phase commutator motor with a shunt characteristic in which the inducing member has a main winding with means for conductively introducing into it an e.m.f. of the same phase as that impressed on the main winding and exciting brushes for permitting



956,686.—Phase Splitter.

an exciting current to flow through the induced members along an axis displaced from the main winding.

956,849. PORTABLE ELECTRIC DRILL; W. C. Hafemeister, Cleveland, Ohio. App. filed Dec. 11, 1908. Motor-driven drill, with details in the mechanical construction of the casing and gearing.

956,855. DYNAMO ELECTRIC MACHINE; F. B. Howell, Schenectady, N. Y. App. filed Oct. 14, 1907. Compensating form-wound windings for dynamos in which the core has overhung slots on one side to receive the windings.

956,868. GAS FIRE LIGHTING DEVICE; C. C. Vail, Columbus, Ohio. App. filed March 11, 1909. A non-conducting button, a spring actuated contact pin working through it, a contact arm projecting laterally from the spring, a contact strip connected with the button and normally separated strips below the button engaged by the pin.

956,870. REFRACTORY WATERPROOF INSULATING COMPOUND; W. H. Wright and Joseph Hoffman, Schenectady, N. Y. App. filed Sept. 4, 1903. Consists of soapstone clay and cryolite ground, compressed and fired.

956,877. TESTER FOR ELECTRIC BLASTING FUSES; F. Beattie, Leete Island, Conn. App. filed Feb. 23, 1909. To show that the fuse is not dangerous by means of an electric light battery and binding post which tests the fuse.

956,893. ALTERNATING CURRENT MOTOR; V. A. Fynn, London, England. App. filed Mar. 6, 1909. Commutator motor of the single-phase induction type, the inducing and commutative winding being closed over brushes and along more than one axis per pole pair. Makes use of a phase converter in series with the induced member.

956,894. ALTERNATING CURRENT MOTOR; V. A. Fynn, London, England. App. filed March 6, 1909. Commutator motor of the single-phase induction type, the induced and commuted winding being closed over brushes along more than one axis per pole pair; the main winding and field winding are displaced with relation to each other with means for short-circuiting the induced member and means for forming a local circuit along an axis displaced from the main winding and for varying the flux produced by the field.

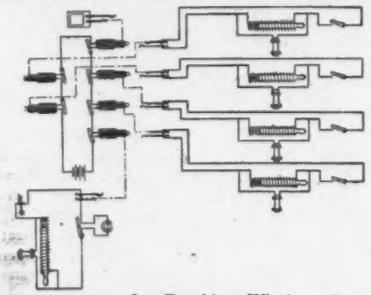
956,898. SIGNALING HORN, ETC.; M. R. Hutchinson, Bronxville, N. Y. App. filed Oct. 2, 1905. The electromagnet which excites the horn is controlled by a circuit in series with the circuit breaker of the igniting apparatus of the gas engine and in parallel with the primary of the spark coil thereof.

956,919. PROCESS FOR THE PREPARATION OF SECONDARY BATTERY PLATES; F. A. R. Wright, Cleveland, Ohio. App. filed March 27, 1909. Negative and positive electrodes are formed in the same tank by placing two series of plates within the tank, the electrolyte containing an oxidizing chemical and the current being reversed from time to time.

956,936. APPARATUS FOR TEACHING WIRELESS TELEGRAPHY; F. E. Butler, Detroit, Mich. App. filed June 26, 1909. A sending key, an adjustable core resistance coil, a buzzer and generator in series receiving circuits and telephone receiver.

956,953. ANTISEPTIC TELEPHONE MOUTHPIECE; W. M. English and H. M. Lichtenstein, San Francisco, Cal. App. filed Oct. 7, 1909. Mouthpiece is formed of glass and carries an internal groove, receiving absorbent wicking which gives off vapor.

956,960. APPARATUS FOR TRANSMITTING AND RECEIVING INFORMATION; J. L. Hall, Schenectady, N. Y. App. filed Oct. 5, 1907. Makes use of synchronously operated motors particularly



956,936—Apparatus for Teaching Wireless Telegraphy.

for training guns. A plurality of circuit controllers are carried by a shaft, two bevelled gears being sleeved on the shaft and rotated in opposite directions and a clutch for connecting either one to the shaft. The transmitter includes rotatable dials and targets bearing indicia which are operated by electromagnets.

956,970. CASING FOR ELECTRIC LAMP SOCKETS; A. L. Jacobs, Boston, Mass. App. filed Nov. 15, 1909. A shell and cap with two parts rotatably adjustable, one on the other with means for locking them against rotation.

956,979. METHOD OF MAKING A PLASTIC MASS FROM COMPOUND OF TUNGSTEN, ETC.; Hans Kreusler, Wilmersdorf, near Berlin, Germany. App. filed June 22, 1907. Makes a paste by heating acid tungstate of ammonium and then cooling and steeping in water.

956,984. WELDING THIN TUBING; H. Lemp, Lynn, Mass. App. filed Sept. 16, 1907. Electrically welds thin metal tubing by enclosing the ends in jackets of weldable material and welding the abutting ends.

957,001. WIRELESS TELEGRAPHY; F. G. Sargent, Graniteville, Mass. App. filed Nov. 9, 1905. A coherer, a receiver and a rotary motor for rotating the coherer to decohere, the rotation being controlled by Hertz waves.

957,020. BOND TESTER; J. B. West, Syracuse, N. Y. App. filed Feb. 1, 1906. For testing joints of electric roads by a portable tester whose terminals consist of spring pressed prick punches electrically connected with a magnet and graduated receiver.

957,050. TELAUTOGRAPH INSTRUMENT; A. L. Golden, Oakland, Cal. App. filed Dec. 15, 1908. A plurality of magnets with movable cores, a universal joint connected with all of them, a lever pivoted in the joint and a writing instrument pivotally secured to the lever.

957,058. ELECTRIC FURNACE; H. W. Hixon, Philadelphia, Pa. App. filed Nov. 30, 1909. For smelting zinc ores in which the hot zinc vapor passes off by means of a central tube with inclined passage.

957,077. AUTOMATIC CONTROL DEVICE, FOR ELEVATORS; L. J. Milke, Baltimore, Md. App. filed Jan. 29, 1909. The elevator hoisting mechanism is made inoperative when a door of the shaft is opened by means of solenoid operated switches constituting circuit breakers arranged in the hoisting and lowering power circuits of the elevator.

957,102. MEANS FOR COOLING DYNAMO ELECTRIC MACHINES; H. Roos, Berlin, Germany. App. filed Oct. 18, 1907. Air cooled by means of a rotary member, a stationary laminated core with radial inlet and outlet ventilating spaces connected by axial channels and separating blocks to close the inlet and outlet spaces against the rotary member.

957,103. MEANS FOR COOLING DYNAMO ELECTRIC MACHINES. H. Roos, Berlin, Germany. App. filed Nov. 23, 1909. See 957,102.